Integrating Blue Infrastructure In Temple Towns: A Case Of Nashik's Sacred Waterscape

Project Phase II report

submitted to Visvesvaraya National Institute of Technology, Nagpur

in partial fulfillment of the requirements for the award of the degree

Master of Technology

In

Urban Planning

by

Kajol Ajay Chaudhari (MT23UPL007)

Under the guidance of

Prof. Rakesh Parmar

Department of Architecture and Planning

Visvesvaraya National Institute of Technology,

Nagpur 440 010

(India)

2024-25

© Visvesvaraya National Institute of Technology (VNIT) 2025

Department of Architecture and planning
Visvesvaraya National Institute of Technology, Nagpur

Declaration

I, **Kajol Chaudhari**, hereby declare that this project phase II titled **"Integrating Blue Infrastructure In Temple Towns: A Case Of Nashik's Sacred Waterscapes"** is carried out by me in the **Department of Architecture and Planning** of Visvesvaraya National Institute of Technology, Nagpur. The work is original and has not been submitted earlier whole or in part for the award of any degree/diploma at this or any other Institution / University.

Kajol Chaudhari

Date:

Certificate

This to certify that the project phase II titled **"Integrating Blue Infrastructure In Temple Towns: A Case Of Nashik Sacred Waterscapes"** issubmitted by **Kajol Chaudhari** in partial fulfillment of the requirements for the awardof the degree of **Master of Technology in Urban Planning** VNITNagpur. The work is comprehensive, complete and fit for final evaluation.

Prof. Rakesh Parmar

Assistant professor,
Dept. of Architecture and Planning,
VNIT, Nagpur

Head, Department of Architecture and Planning
VNIT, Nagpur
Date:

Department of Architecture and Planning, Visvesvaraya National Institute of Technology, Nagpur

Acknowledgment

The completion of this dissertation has been a collaborative effort, and I owe my gratitude to several individuals who have played a crucial role in its realization. I would like to express my deepest gratitude to my project guide, **Prof. Rakesh Parmar**, Assistant Professor in the Department of Architecture and Planning, for his invaluable guidance, constant support, and encouragement throughout the course of this research. His insights and expertise have been pivotal in shaping this work.

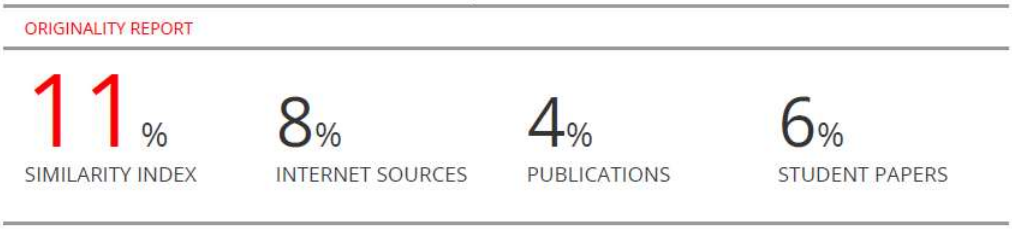
I express my deep gratitude to **Dr. Sameer Deshkar**, Head of the Department, Department of Architecture and Planning, and **Dr. Prem Lal Patel**, Director, for providing an enriching academic environment that facilitated my research for phase II.

Lastly, I am grateful to my parents for their moral and never-ending support and to my cherishing companions, especially Er. Mahi Gajbhiye, Ar. Priyanshi Gupta, Er. Himanshu Geed, Ar. Divya Nair, Ar. Akshata Parbate and other colleagues for their unwavering encouragement, patience, and belief in me. Their support has been my anchor during this entire process.

- **Kajol Chaudhari**
(MT23UPL007)

VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY, NAGPUR

Non – Plagiarism Certificate



Certified that MTech. Thesis titled **"Integrating Blue Infrastructure In Temple Towns: A Case Of Nashik's Sacred Waterscapes"** submitted by **Kajol Chaudhari** Enrolment No. MT23UPL007 ID no.**30105** is original in nature and not copied from any literature material. Due credit has been given to the original researcher wherever referred.

Prof. Rakesh Parmar

Assistant professor,
Dept. of Architecture and Planning, VNIT, Nagpur

ABSTRACT

Water has a crucial role in the development and maintenance of cities. Beyond its utilitarian use, water has deep religious importance in Hinduism, as it is entwined with the cosmic cycle of Hindu mythology. Historically, temple towns in India have evolved along water bodies, forming sacred landscapes that reflect the country's rich cultural heritage. These towns reflect a dynamic interplay between heritage, ecology, and the forces of urbanization. However, the rapid urbanization and development have put forth critical challenges, steadily disrupting the delicate balance between heritage, ecology, and urban life. Nashik, situated on the banks of the Godavari River, stands as a significant pilgrimage center. In order to preserve Nashik's sacred landscape, which is entwined with social, cultural, religious, and ecological aspects, this study focuses on the city's water system. The study explores the many water body typologies found in Nashik with the goal of understanding how they have changed throughout time. This study seeks to formulate a holistic framework and cohesive strategies, ultimately leading to a context-sensitive action plan tailored to the unique conditions of Nashik. To achieve this, a multi-pronged assessment method was employed, combining GIS-based spatial analysis, field observations, and stakeholder consultations. This approach enabled a detailed evaluation of ecological degradation, infrastructural shortcomings, and tourism-induced stress along the city's riverfront. The gap analysis uncovered significant disconnects between heritage conservation, water-sensitive planning, and tourism management. To guide interventions, a scoring system was devised to prioritize zones based on environmental vulnerability, pilgrimage density, and infrastructure stress. This formed the basis for a holistic, site-responsive strategy aimed at revitalizing and safeguarding Nashik's sacred water resources.

The proposed framework serves as a replicable model for other cities rooted in deep religious traditions and grappling with the deterioration of their water infrastructure. It offers a strategic blueprint for the restoration and long-term protection of sacredscapes through integrated, culturally informed water management—applicable at both the city and regional scale.

Keywords: Temple towns, Sacredscapes, Water-sensitive planning, Pilgrimage tourism, Heritage conservation, GIS-based analysis.

Table Of Contents

ABSTRACT

1 CHAPTER I - Introduction....1
1.1 Background....1
1.2 Indian tourism scenario....2
1.3 Need of the study....3
1.3.1 Findings from Phase 1....4
1.4 Aim, Objective, Scope and Limitation....5
1.5 Methodology....6
2 CHAPTER 2: Literature review....8
2.1 Existing scenario of Sacred water bodies of India....8
2.1.1 Impacts of urbanization:....8
2.1.2 Sacred river....9
2.2 Policy Framework....9
2.2.1 Policies guidelines and scheme encompassing the development of temple towns.....10
2.2.2 SDG's....11
2.3 Case studies....12
3 CHAPTER 3- STUDY AREA....15
3.1 Background study....15
3.2 Selection process....16
3.2.1 Context of the cities....16
3.2.2 Issues pertaining....16
3.2.3 Conclusion....17
3.3 City Profile....17
3.3.1 Introduction....17
3.3.2 Demographics:....19
3.3.3 Religious Tourism Circuit....21
3.3.4 Water systems & drainage....22
3.4 Data Collection & processing....26
4 Chapter 4: Parameters & Tools....29
5 Chapter 5: Data Analysis & Results....31
5.1 City-Level Contextual Assessment....31
5.1.1 Overview of Tourism and Pilgrimage Activity....31
5.1.2 Riparian Zone....33
5.1.3 Groundwater Potential Mapping....36
5.1.4 Sewage and Drainage Infrastructure:....38

5.2 Data analysis 39
5.3 Identification of affected wards 43
6 CHAPTER 6: Proposals 45
6.1 Proposal 01 : Constructed Wetlands 46
6.2 Proposed 02 49
6.3 Proposal 03 50
6.4 Recommendations 53
6.5 INFERENCE 57
7 Conclusion: 58
References: 59

LIST OF FIGURES

Figure 1 Map & statistics of international tourist arrivals and tourism receipt Source: UNWTO 1
Figure 2 Classification of tourism
Figure 3 Relative severity of risks over a two and 10-year period 1
Figure 4 Share of India in International Tourist Arrivals in World and Asia & the-Pacific Region during 2011-2022 3
Figure 5 Analysis From Phase I 4
Figure 6: Cumulative analysis of parameters 5
Figure 7 Methodology for Phase- II 7
Figure 8 Physical Environment Modified 8
Figure 9 urban planning domains & mass tourism issues faced 8
Figure 10 Puri heritage corridor Figure 11 Ujjain's Lake connetion for a better drainage and ecological flow 13
Figure 12 Madurai's blue green networking and ghat development 13
Figure 13 Causes of environmental degradation in temple town 14
Figure 14 LULC of Alandi, Pandharpur, Nashik 16
Figure 15 LULC 2005 and 2015 18
Figure 16 LULC 2025
Figure 17 Direction of growth of city 18
Figure 18 Land use & Land cover percentage 19
Figure 19 Existing land use of Nashik Municipal Corporation 20

Figure 20: Population growth 20
Figure 21: Floating Population During festival 21
Figure 22 Socio- Religious tourism circuit 22
Figure 23 Slope map 23
Figure 24 Water Bodies in Nashik city 23
Figure 25 Water supply demand of NMC 24
Figure 26 Pre monsoon depth to water level of aquifer I and II 25
Figure 27 Survey Question for the existing water system in the city 26
Figure 28: Concentration of tourists annually v/s during Kumbh Mela 31
Figure 29 Festive Timeline 2024 32
Figure 30 Religious Places in the cold city area 32
Figure 31 Water and the associated actives within the religio- socio cultural & ecological domain 33
Figure 32 Concretized cosmic stretch of the river 33
Figure 33 pre-monsoon and post monsoon condition of Ram kund due to anthropogenic activities 34
Figure 34 Uma kund, a perennial spring source : parineta Dandekar 34
Figure 35 100 m Buffer around water bodies 35
Figure 36 Soil & linenament density map 36
Figure 37 Slope and Drainage density map 36
Figure 38 watershed analysis and LULC 2025 map 37
Figure 39 Potential areas of ground water recharge 37
Figure 40 Ward status for sewage disposal 38
Figure 41 Effluent points 38
Figure 42 potential areas of infiltration 43
Figure 43 Network analysis 44
Figure 44 Overall Issues indetified in the study area 44
Figure 45 Identified area of intervention 46
Figure 46 Existing morphology of the site 47
Figure 47 fucntion of wetland 47
Figure 48 Proposed Intervention 1 48
Figure 49 Conceptual site section for ICW 48
Figure 50 Identification of site for Proposal 2 49

Figure 51 Indentification of confliting strecthes of drains.....51
Figure 52 Existing condition of stretch.....51
Figure 53: Section of river embankment 52
Figure 54 Section for the rihe bibuffer and bioswale 53
Figure 55 Proposed condition of Sewer connections.....54
Figure 56 Treatment and reuse scheme 55

LIST OF TABLES

Table 1: Top 10 States /UTs with Polluted River Stretches. 9
Table 2: Policy Framework of States with respect to IPS 10
Table 3 Maharashtra Famous Temple Towns and associated natural features of importance (source: Author).....15
Table 4 LULC percentage of 2005, 2015 &2025 18
Table 5existing and Proposed Sewage Treatment plants.....25
Table 6 Parameters & Sub-parameters derived from the study 29
Table 7 Weightage of map for overlay analysis 37
Table 8 Cumulative parameters and ratings.....40
Table 9 Scoring range of URM index (source: URMP Framework).....42
Table 10 Recommended Buffer width.....53

1 CHAPTER I - Introduction

1.1 Background

Tourism has become a popular global leisure activity. The World Travel and Tourism Council (WTTC) has identified India as one of the world's foremost tourist growth centers in the coming decade. Travel & Tourism is deeply rooted in the Indian system, be it for business, pilgrimage, or education. (UNWTO,2024)

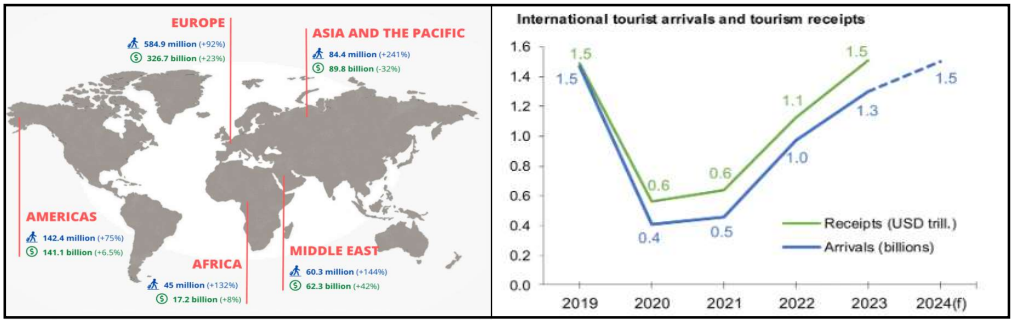


Figure 1 Map & statistics of international tourist arrivals and tourism receipt Source: UNWTO

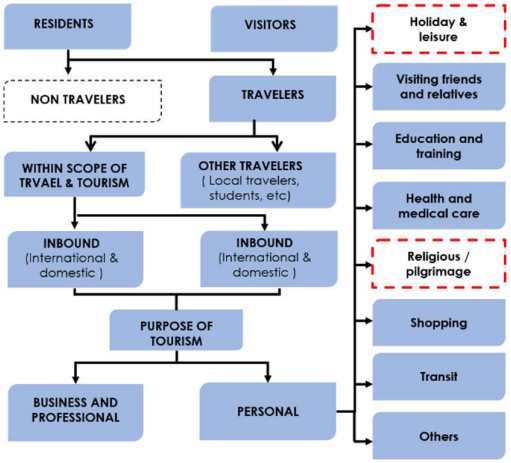


Figure 2 Classification of tourism

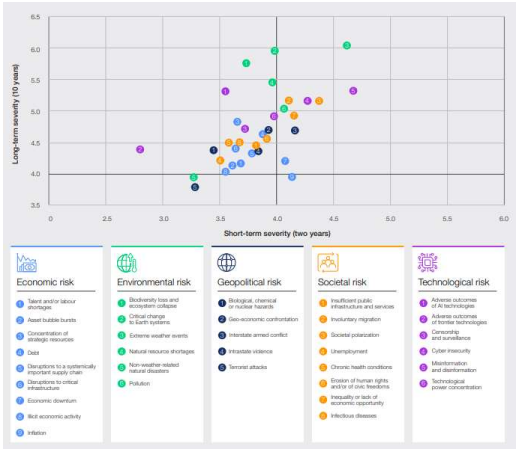


Figure 3 Relative severity of risks over a two and 10-year period

Most touristic places are extensively associated with nature, their physical setting being near hilltops, flowing water or forests, making Tourism an extremely climate-responsive sector that is also strongly influenced by many factors, including the state of the natural environment (Scott, Hall, & G€ossling, 2019).

Every year millions of people decide to spend their leisure time/holiday periods in areas that somehow (directly or less directly) have a close relationship with water, whether coastal or inland. (Brito & Silveira, 2023) Cities and river life create unique urban environments, with many built beside rivers.

Figure 3 shows a pressing concern for environmental challenges having a significant global impact. In an effort to solve these concerns, there is a growing recognition of the potential role blue & green spaces can play. (*Travel & Tourism Development Index*, 2024)

Table 1 Tourism and environment issues

Environmental Issue	Connection to tourism	Environmental problems arising from / addressed by
Negative effects of increased tourism activity		
Changes of biological resources	Tourism activities such as hunting, fishing, camping and other sports may lead to depletion of ecosystems and species	• Loss of biological diversity • Soil contamination
Land use and environmental restructuring	Construction of roads, hotels, resorts, ropeways and other infrastructure	• Loss of biological diversity • Soil erosion
Waste discharge in water, air and land	Increase in the number of persons in tourism areas leads to increase in amount of waste	• Air pollution • Water pollution • Soil contamination
Water use for human activities	Increased consumption of sparse resources during tourism seasons	• Resource scarcity
Energy production and consumption	Tourism will lead to increased use of various means of transport	• Greenhouse effect • Destruction of ozone layer • Air pollution
Human health and environmental disasters	Emission of noise and gases from traffic will affect human health and	• Noise pollution • Air pollution

1.2 Indian tourism scenario

Religious Tourism can be defined as travel with the core motive of experiencing religious forms, which includes various products such as art, culture, tradition, and architecture of a specific time period. (UNWTO)

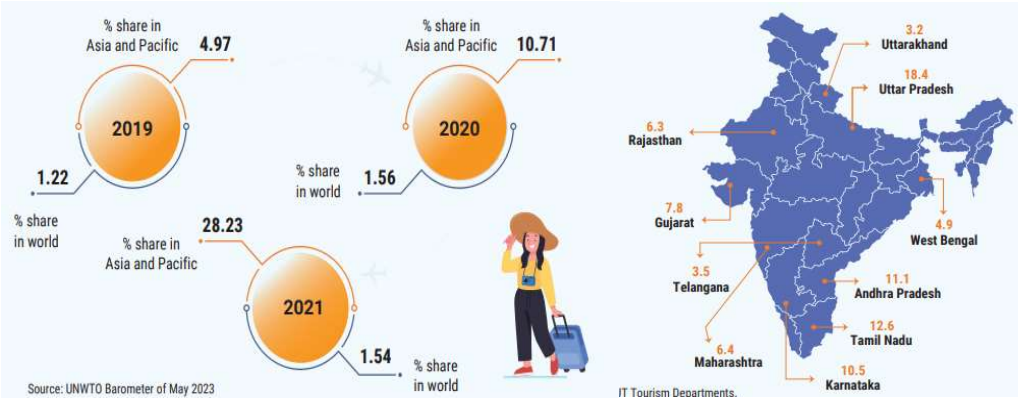


Figure 4 Share of India in International Tourist Arrivals in World and Asia & the-Pacific Region during 2011-2022

The Indian tourism sector, with millions of domestic tourists annually, boosts national integration and economic transformation. Religious destinations in India are a significant part of the country's cultural heritage and tourism, contributing to social, cultural, and economic development.

1.3 Need of the study

Religious tourism can significantly impact the environment by straining local ecosystems and natural resources, thereby worsening existing environmental issues. This underscores the urgent need for sustainable tourism practices that are responsive to local conditions. Each temple town has unique cultural, geographical, and socio-economic contexts that must be understood to implement effective strategies. Integrating green infrastructure—comprising ecological zones, hubs, and corridors—helps maintain landscape connectivity and can guide the development of alternative tourist routes, easing pressure on vulnerable areas. Moreover, adopting climate change mitigation and adaptation measures can regulate microclimates and improve water management through the implementation of blue-green infrastructure. Lastly, ecological planning also enhances public health and well-being, as it counters the negative effects of industrialization on the environment and promotes long-term sustainability in tourism.

1.3.1 Findings from Phase 1

The Phase 1 analysis of nine Indian pilgrimage towns reveals a strong foundation in cultural heritage, landscape quality, and urban livability, reflecting the spiritual and tourism value of these cities. However, critical gaps exist in surface water quality, stormwater management, waste systems, and groundwater health, pointing to ecological strain from unregulated tourism and urban expansion. Although tourism infrastructure is reasonably developed, cumulative analysis reveals a deficiency in blue-green infrastructure and environmental resilience. This mismatch highlights the urgent need for integrated planning that balances heritage conservation with sustainable water, waste, and ecosystem management.

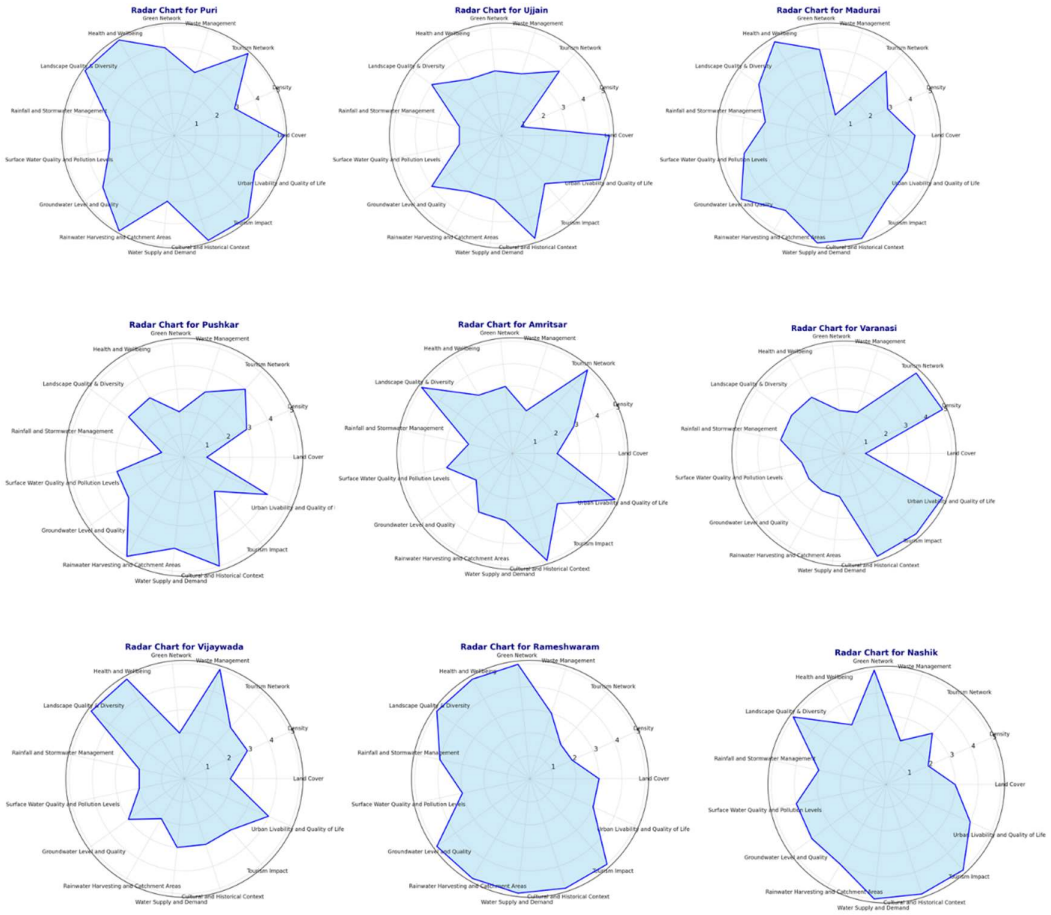

Radar Chart for Puri
Radar Chart for Ujjain
Radar Chart for Madurai
Radar Chart for Pushkar
Radar Chart for Amritsar
Radar Chart for Varanasi
Radar Chart for Vijaywada
Radar Chart for Rameshwaram
Radar Chart for Nashik

Figure 5 Analysis From Phase I

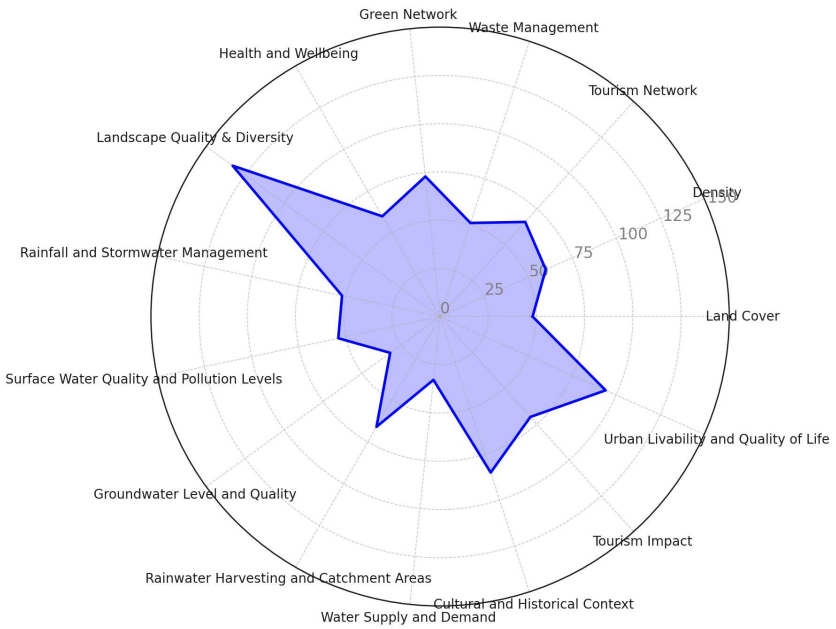


Figure 6: Cumulative analysis of parameters

These findings highlight the need for blue-green infrastructure, carrying capacity assessment, and integrated river-sensitive planning in the next phase.

1.4 Aim, Objective, Scope and Limitation

Aim: To understand tourism dynamics of blue infrastructure in Nashik city, identifying their impacts and proposing design and policy interventions for sustainable urban development.

Objective:

1. To study religio- cultural values of blue infrastructure in context to temple towns of Maharashtra.
2. To identify tourism dynamics & influences on blue infrastructure in context to temple towns of Maharashtra.
3. To identify adverse impacts of tourism on drainage networks, transformations, delineations functions and quality of water bodies and their associated impacts.
4. To Study temple towns Impacts and dynamics in selected scales of varying scales.

5. To propose design and policy interventions that take advantage of water's historical and spiritual importance to create inclusive, ecologically sensitive, and culturally vibrant urban spaces.

Scope:

1. This study explores the water resources of temple towns, considering both their physical attributes and cultural significance.

2. Proposals for enhancing the functionality of water systems while preserving their cultural and ecological significance.

Limitations:

1. The study is limited to the city scale and does not extend to a regional analysis.
2. It focuses on the potential for planning and integrating blue-green infrastructure within the urban fabric of temple towns.
3. The study excludes the economic valuation of solutions and their cost-effectiveness analysis.

1.5 Methodology

The research methodology of the thesis is structured in phases, beginning with a research framework that describes its scope, aims, and limitations. It presents the subject and describes the process of data collection, including primary and secondary data. Primary data consist of visual site surveys, home public opinion surveys, expert opinion, and mapping exercises, and secondary data consist of records, standards, government schemes, and spatial plans. A literature review examines research papers and case studies of comparable temple towns in order to determine appropriate parameters. The parameters guide the analysis of the interaction between tourism, temple town dynamics, and sustainability management. Analysis involves weighing and ranking parameters to determine key issues and gaps. Strategic recommendations emerge from the analysis, proposing frameworks and interventions for blue-green infrastructure management in the context of urbanization, and short-term, medium-term, and long-term goals for the city.

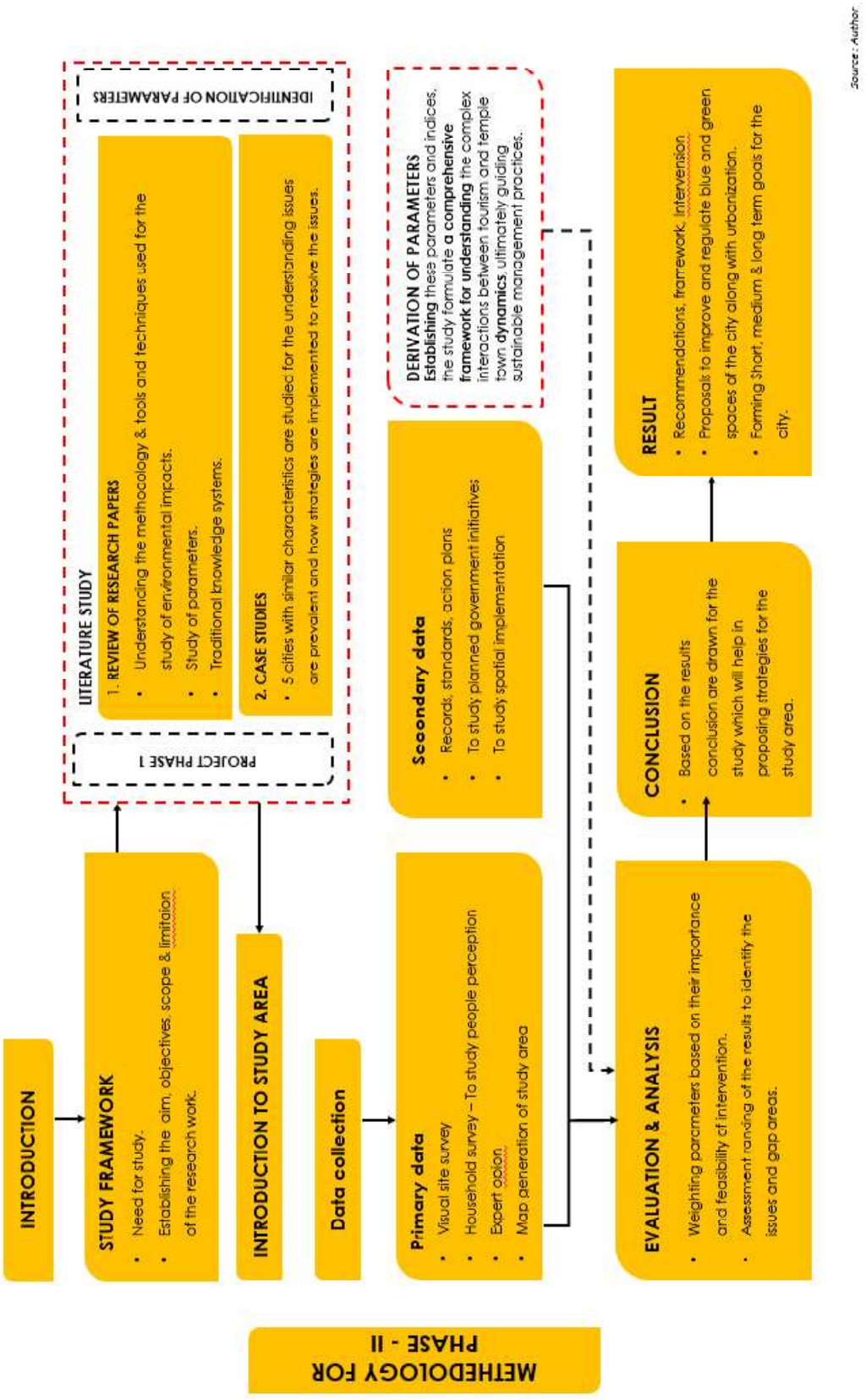

METHEDOLOGY FOR PHASE - II
INTRODUCTION
STUDY FRAMEWORK
Need for study.
Establishing the aim, objectives, scope & limitation of the research work.
PROJECT PHASE 1
LITERATURE STUDY
1. REVIEW OF RESEARCH PAPERS
Understanding the methodology & tools and techniques used for the study of environmental impacts.
Study of parameters.
Traditional knowledge systems.
2. CASE STUDIES
5 cities with similar characteristics are studied for the understanding issues are prevalent and how strategies are implemented to resolve the issues.
IDENTIFICATION OF PARAMETERS
INTRODUCTION TO STUDY AREA
Data collection
Primary data
Visual site survey
Household survey – To study people perception
Expert option
Map generation of study area
Scoondary data
Records, standards, action plans
To study planned government initiatives
To study spatial implementation
DERIVATION OF PARAMETERS
Establishing these parameters and indices, the study formulate a comprehensive framework for understanding the complex interactions between tourism and temple town dynamics, ultimately guiding sustainable management practices.
EVALUATION & ANALYSIS
Weighting parameters based on their importance and feasibility of intervention.
Assessment ranking of the results to identify the issues and gap areas.
CONCLUSION
Based on the results conclusion are drawn for the study which will help in proposing strategies for the study area.
RESULT
Recommendations, framework, intervension
Proposals to improve and regulate blue and green spaces of the city along with urbanization.
Forming short, medium & long term goals for the city.
Source : Author

Figure 7 Methodology for Phase- II

2 CHAPTER 2: Literature review

2.1 Existing scenario of Sacred water bodies of India

2.1.1 Impacts of urbanization:

Since every religious centers have been traditionally small towns, rapid urbanizations bring its own pressure such as high stress on infrastructure due to a huge influx of population, encroachment of the existing resources, dilapidating built heritage and urban space, water tanks, increasing traffic congestion, etc.

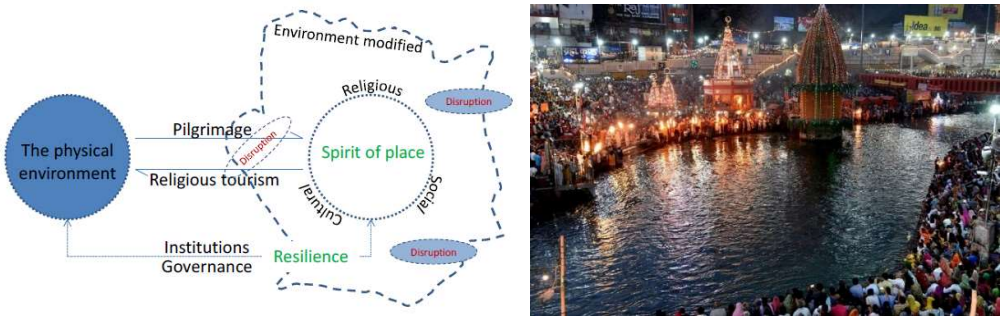


Figure 8 Physical Environment Modified

The inner city core starts to deteriorate to a very pathetic condition devoid of its original character. As the sacred place has to accommodate the floating population more than its capacity with no special planning and associated infrastructure for the additional frequent influx. Hence it is important to analyse the impact of pilgrimage on religious cities and the extent of issues and challenges emanating from it.(Chandan & Kumar, 2019; Shinde, 2022)

Land Management	Temporary plotting, permanent plotting, ecology of site and conservation
Traffic and Transport	Vehicular movement, parking, bus terminus and arrival points, railway station, pedestrian movement, local transportation,
Security, Law and Order	Crowd management, pilgrim security, control towers, barricades, fire safety, emergency, disaster management,
Sites and Services	Drainage, water supply, electrification, storm water
Physical development	Road development, water bodies, public places, temple precinct, bus stands and railway stations
Infrastructure Needs	Public toilets / Drinking water, Health center, Information center, Rest Places, Locker and Baggage, Storage facility, community center, mela exhibition ground, shopping stalls
River front Project	Ghat construction and maintenance, bathing event and space management, pedestrian movement, water management, cleaning of Ghats
Tourism Facilities	Information center, travel agent offices, security arrangements, internet facilities

Figure 9 urban planning domains & mass tourism issues faced

2.1.2 Sacred river

River pollution in India is a critical issue, with several stretches falling under Priority Class I, indicating severe pollution levels. The Biochemical Oxygen Demand (BOD) values in these stretches, particularly those exceeding 5 mg/L, indicate high organic pollution and degraded water quality. Rivers like the Ganga and Yamuna show multiple polluted stretches across states like Uttar Pradesh, Delhi, and Bihar, with BOD levels reaching up to 12 mg/L in some areas. (River stretches for restoration of water quality – 2022).

Table 2: Top 10 States /UTs with Polluted River Stretches.

Rank	State/Union Territory	Priority Class [BOD in mg/l]					Total PRS
		I Above >30	II 20 – 30	III 10-20	IV 6-10	V 3-6	
1	Maharashtra	4	5	18	17	11	55
2	Bihar	-	1	2	7	8	18
3	Kerala	-	-	1	2	15	18
4	Karnataka	3	-		3	11	17
5	Uttar Pradesh	6	-	1	2	8	17
6	Madhya Pradesh	2	-	1	5	11	19
7	Gujarat	6	1	1	1	4	13
8	Manipur	-	-	-	2	11	13
9	Rajasthan	2	-	1	4	7	14
10	Tamil Nadu	4	1	1	1	3	10

2.2 Policy Framework

The four states with most PRS shows us the key rivers affected, what are the challenges and the focus area. Different states have adopted different policy frameworks and focus areas to combat river pollution, such as Uttar Pradesh relying on the State Water Policy and National Green Tribunal orders, Tamil Nadu prioritizing public awareness and industrial regulation, and Gujarat focusing on wastewater treatment and recycling. The government agenda has led to a significant change in the priority class of PRS in Maharashtra from the year 2018 to 2022. Still, rivers like Godavari, Mula & Chandrabhadra have improved in their pollution status but still face significant challenges that need to be addressed. Continued monitoring and enhanced measures are

essential to sustain improvements and tackle areas where water quality is declining. (River stretches for restoration of water quality – 2022).

Table 3: Policy Framework of States with respect to IPS

Aspect	Policy Framework	Focus Areas	Key Rivers Affected	Challenges
Uttar Pradesh	State Water Policy; NGT Orders	Sewage treatment; enforcement	Ganga, Gomti	Non-functional STPs; high pollution levels
Tamil Nadu	River Conservation Policy; NGT Interventions	Public awareness; industrial regulation	Cooum, Adyar	Industrial effluents; festival waste disposal
Maharashtra	Nanami Gange, Indrayani Project; MPCB Regulations	Infrastructure development; PPPs	Godavari, Mula-Mutha	Industrial discharge; **public engagement; festival waste**
Gujarat	Wastewater Recycling Policy; GPCB Regulations	Wastewater treatment and recycling	Sabarmati, Khari, Amlakhadi	High industrial pollution

From the above affected rivers Ganga , Godavari, indryani , chandrabagha are of religious importance and are under stress due to pollution from the surrounding industrial discharge with additional tourism activities stress. While efforts are made to revive Ganga , Maharashtra lacks in terms of infrastructure development even though the impact of tourism is more or likely on similar scale.

2.2.1 Policies guidelines and scheme encompassing the development of temple towns.

To address such concerns the Ministry of Tourism in 2021 shows an inclination to the requirement of integrated development that encompasses city planning, basic services, quality of life, economy, livelihoods, cleanliness, security, reinvigoration, and character.

1. PRASAD – holistic planning of the pilgrim town. To strengthen pilgrimage destinations by preserving cultural heritage, improving connectivity, and improving infrastructure—all of which would benefit local economies and encourage spiritual tourism.
2. HRIDAY – City development plan for heritage towns analysis and Solutions. It aims to revitalize and protect urban regions' cultural heritage while fostering

sustainable settings that improve the quality of life for locals and encourage tourism.

3. SWADESH DARSHAN –identifies tourist ciruit. Promote several tourism themes like spirituality and eco-tourism, as well as sustainable community development.

2.2.2 SDG's

The 17 interrelated SDG goals aim to address global issues and advance sustainable development. By aligning tourism practices with the UN's Sustainable Development Goals, stakeholders can work towards mitigating the negative impacts on natural systems while enhancing the cultural significance of these sacred spaces.

- SDG 6 – Clean Water & sanitation: Investments in sustainable tourism infrastructure can enhance access to clean water and sanitation facilities in temple towns. By revitalizing urban water cycles through the restoration of temple tanks and other natural water bodies, communities can ensure that these resources remain viable for both residents and tourists. Efforts like Mission Amrit Sarovar aim to rejuvenate ponds across India, highlighting their importance for ecological sustainability.
- SDG 11-Sustainable Cities & Communities: Tourists rely on cultural and natural heritage, which can be preserved, urban infrastructure and accessibility can be improved, and regeneration can be encouraged. Green investments should make cities smarter and greener for both locals and visitors.
- SDG 13 – Climate Action: Integrating green spaces within temple towns—such as parks surrounding sacred sites—can help mitigate climate change impacts by absorbing carbon dioxide and managing stormwater runoff. These natural areas also provide resilience against extreme weather events, safeguarding both cultural heritage and community livelihoods.
- SDG 14 – Life below water: waters are sensitive to human intervention and in many riverine systems, the ecosystems they support are showing considerable stress by human activities. waters are an important but surprisingly neglected aspect of the global tourism industry. Temple tanks are integral to local ecosystems but are often neglected in conservation efforts. By recognizing their ecological significance,

sustainable tourism initiatives can promote the protection of aquatic life while enhancing the cultural practices associated with these water bodies. Effective management strategies can help maintain healthy riverine systems crucial for biodiversity.

- SDG 15 – Life on Land: A destination's rich biodiversity and natural history are frequently the primary draws for travelers. BGI can contribute significantly to the ethical handling of the vulnerable areas by providing local residents with an alternate source of income in addition to protecting and conserving biodiversity. (UNWTO, 2020)

2.3 Case studies

Table 4 Case study comparison

City	Type of Water Bodies Present	Issues Identified	Proposals & Strategies	Key Initiatives for Safeguarding Water Bodies
Puri	- Sea (Mahodadhi) - Rivers: Musa, Mangala - Sacred tanks - Sweet water zones - Wetlands, ponds, forest rivulets (Nuanai, Kusabhadra)	- River beds dry in summer, flood in monsoon - River pollution due to religious practices - Encroachment near seashore impacting dunes, nesting grounds - Groundwater contamination - Choked drains, poor stormwater management	- Shree Mandir Parikrama Project (SMPP) with green buffers - Revitalization of Musa River - Heritage Corridor (70m tourist-friendly zone) - Declaration of Sweet Water Zone as "no-construction" zone	- SMPP includes green infrastructure - Rejuvenation of rivers (Musa) - Preservation of sweet water zones -Protection of Balukhanda forest edge
Ujjain	- River: Kshipra - Rudra Sagar Lake - Temple tanks - Stepwells	- Seasonal river (Kshipra) dries in summer - BOD spike post-Kumbh Mela - Poor post-event waste management - Stampede risk, encroachment on natural drains - Polluted lakes from rituals	- Mahakal Heritage Corridor - GIS-based walkability & safety network - Surface runoff network connected to Rudra Sagar - Public space reuse post-Mela	- Sewer network connected to catchments - Universal access to ghats - Aquatic weed removal for lake restoration - Flood mitigation via natural drain restoration

Madurai	- Rivers: Vaigai, Kruthumal - Temple tanks - City lakes - Channel systems	- Disconnect between temple tanks and lakes - Flooding from poor blue infrastructure - Encroachments, clogged drains from tourism waste - Limited access to open spaces - Cultural degradation due to commercialization	- Blue-Green Infrastructure Plan - Development of riverfront landscapes - Temple tourism corridor (pedestrian-first) - Eco-sensitive zone identification - Rainwater harvesting enforcement	- Green corridor between lakes and tanks - Riverfront development - Pedestrian infrastructure enhancement - Policy framework for flood/drought resilience

Figure 10 Puri heritage corridor Figure 11 Ujjain's Lake connetion for a better drainage and ecological flow

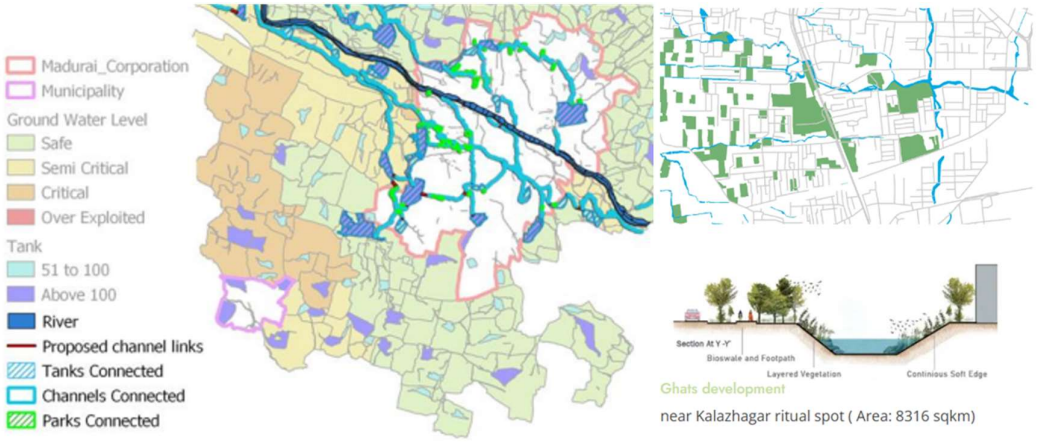


Figure 12 Madurai's blue green networking and ghat development

These cases highlight the significance of water-sensitive spatial planning, heritage-led development, and multi-scalar ecological strategies. They also underscore the importance of regulatory frameworks such as land-use overlays and eco-sensitive zoning. Collectively, these examples offer a valuable foundation for developing research parameters in urban hydrology, heritage-tourism planning, and climate-resilient infrastructure. The lessons derived reinforce spatial planning as a powerful tool

to safeguard cultural heritage while regenerating natural systems in sacred urban environments.

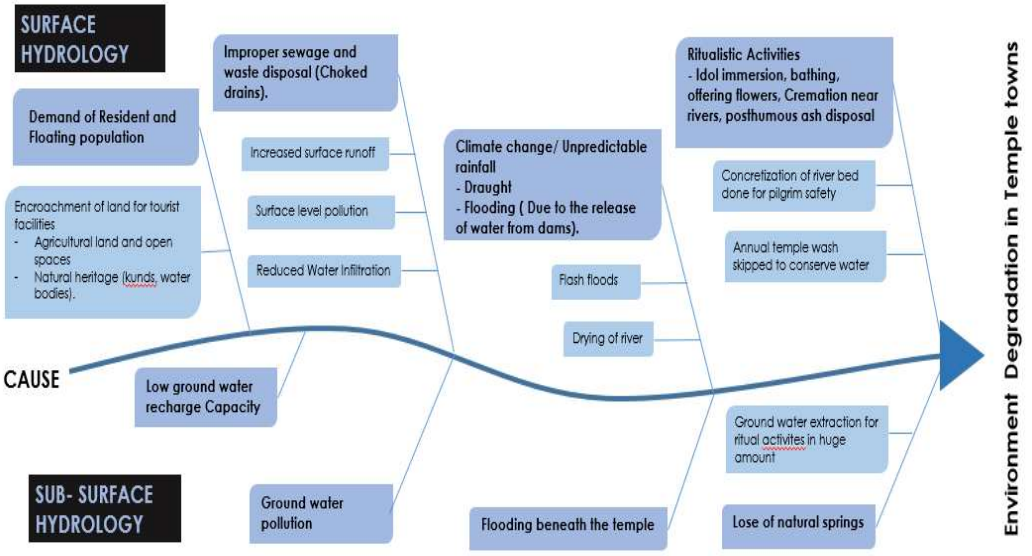

SURFACE HYDROLOGY
Improper sewage and waste disposal (Choked drains).
Demand of Resident and Floating population
Increased surface runoff
Climate change/ Unpredictable rainfall
- Draught
- Flooding (Due to the release of water from dams).
Ritualistic Activities
- Idol immersion, bathing, offering flowers, Cremation near rivers, posthumous ash disposal
Concretization of river bed done for pilgrim safety
Encroachment of land for tourist facilities
- Agricultural land and open spaces
- Natural heritage (kunds, water bodies).
Surface level pollution
Annual temple wash skipped to conserve water
Reduced Water Infiltration
Flash floods
Drying of river
CAUSE
Low ground water recharge Capacity
Ground water extraction for ritual activites in huge amount
SUB- SURFACE HYDROLOGY
Ground water pollution
Flooding beneath the temple
Lose of natural springs
Environment Degradation in Temple towns

Figure 13 Causes of environmental degradation in temple town

3 CHAPTER 3- STUDY AREA

3.1 Background study

Maharashtra is a popular destination for both domestic and international tourists due to its abundance of UNESCO World Heritage Sites and strong religious tourism. The majority of its holy sites are located in small cities with populations under two lakh, where the local government is typically underfunded and has the infrastructure necessary to manage the growing number of tourists. The majority of temple towns, whether urban, semi-urban, or rural, are located in close proximity to rivers, hills, or other natural features, which increase their religious significance as well as environmental appeal. Major rivers like the Godavari, Chandrabhaga, and Indrayani are not only sacred elements in religious rites but also are integral parts of the ecological system of the towns. This connection highlights the significance of integrated approaches of the conservation of heritage, ecological integrity, and urban planning in these culturally important towns.

Table 5 Maharashtra Famous Temple Towns and associated natural features of importance (source: Author)

Town	Famous Temple/Spot	Classification	Natural Feature of Importance
Shirdi	Sai Baba Temple	Urban	N/A
Nashik	Trimbakeshwar Temple	Urban	Godavari River
Aurangabad	Grishneshwar Jyotirlinga Temple	Urban	Ellora Caves
Kolhapur	Mahalakshmi Temple	Urban	Panchganga River
Pune	Dagadusheth Halwai Ganpati Temple	Urban	N/A
Pali	Ballaleshwar Temple	Semi-Urban	Lush Greenery
Tuljapur	Tulja Bhavani Temple	Semi-Urban	Serene Landscapes
Morgaon	Shri Mayureshwar Ganapati Temple	Semi-Urban	Scenic Hill Views
Pandharpur	Shri Vitthal Rukimini Mandir	Urban	Chandrabhagā River
Jejuri	Khandoba Temple	Rural	Yadavagiri Hills
Lonar	Daityasudan Temple	Rural	Lonar Lake (Crater)
Hottal	Hottal Temple	Rural	Scenic Rural Landscape
Bhimashankar	Bhimashankar Temple	Rural	Sahyadri Hills, Bhimashankar wildlife sanctuary
Alandi	Saint Dnyaneshwar's Samadhi Mandir	Semi-Urban	Indrayani River
Akkalkot	Shri Swami Samarth Maharaj Temple	Urban	Banyan Tree
Mahabaleshwar	Mahabaleshwar Temple	Urban	Confluence of five rivers (Krishna, Venna, Koyna, Savitri, Gayatri)

3.2 Selection process

3.2.1 Context of the cities

The towns of Alandi**,** Pandharpur, and Nashik have deep religious significance, proximity to major rivers, and their role as prominent pilgrimage destinations in Maharashtra. These towns witness a huge influx of pilgrims during festivals and throughout the year, placing immense pressure on their urban infrastructure, water resources, and natural ecosystems. The rivers flowing through these towns—Indrayani in Alandi, Chandrabhaga in Pandharpur, and Godavari in Nashik—hold both cultural and ecological importance, making the management of pollution, land use, and infrastructure vital for sustainable urban planning.

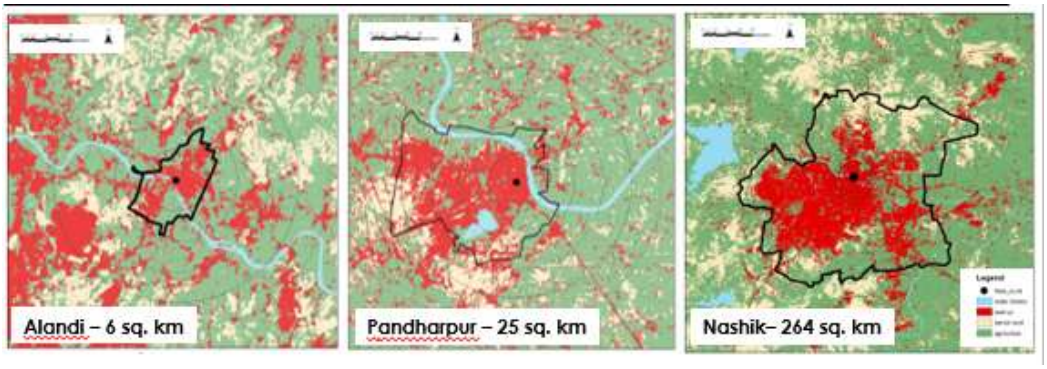


Figure 14 LULC of Alandi, Pandharpur, Nashik

3.2.2 Issues pertaining

Alandi: At the time of Wari period there are huge number of Warkaris visiting Alandi for worshiping god. The devotees inflow is 10 times of the resident population. The Indrayani River is heavily polluted by untreated sewage, religious activities, urban infrastructure stress, and runoff pollution. The town's infrastructure is under strain due to population growth and pilgrimage traffic. Groundwater levels have dropped, and the town faces an inadequate supply of clean drinking water. (City Development Plan Alandi 2017- 2037, 2017; MPCB, n.d.)

Pandharpur: At the time of Wari period there are huge number of Warkaris visiting Pandharpur for worshiping god. The devotees inflow is 11 times of the resident population. The current wastewater treatment plant is inefficient and under-capacity, causing issues during peak pilgrim seasons. Infrastructure development, sand dredging,

stagnant river flow, and improper disposal of waste contribute to heat island effects and biodiversity loss. (City development plan

Nashik: the city experiences more than twice its population in devotees annually and during Kumbh Mela the influx exponentially increases by 30%. Flooding near temples, heavy rainfall, and inadequate stormwater drainage lead to water accumulation near sites like Ramkund. Concretization of sacred sites and pollution of the Godavari increase flooding risks. Development of public parks ignores natural floodlines, highlighting resource scarcity and lack of environmental planning. (Draft Development plan, 2016)

3.2.3 Conclusion

Alandhi, Pandharpur, and Nashik, while varying significantly in scale, all experience substantial tourist influxes during the Wari pilgrimage and Shravan Somvar festivals. These events, coupled with unpredictable rainfall patterns leading to drought, place considerable stress on the environment and resources of these temple towns. The drying rivers not only impede devotees' ritual practices but also highlight broader issues of water management and ecological balance. Among the three towns studied, Nashik presents the most complex interplay of challenges involving religious activities, urban sprawl, ecological degradation, and water stress. Considering these factors, Nashik emerges as a crucial study area. The proposals and design strategies implemented in Nashik, after a thorough investigation of its specific issues and opportunities, can serve as a model for addressing similar challenges in other temple towns across Maharashtra. The insights gained and solutions developed in Nashik can be adapted and applied to Alandhi, Pandharpur, and potentially other pilgrimage sites facing comparable environmental pressures, thus ensuring the sustainability and preservation of both ecological integrity and cultural traditions.

3.3 City Profile

3.3.1 Introduction

Nashik's mythological, historical, social, and cultural significance give it a distinct identity. The city, situated on the banks of the Godavari River, is a sacred place for Hindus across the globe, with the spectacular 'Kumbh Mela' attracting more than 10

million people every 12 years. Religious tourism, industrialization, and the agriculture sector, three are major contributors of the economy to Nashik city. Owing to these factors the city is expanding in all directions.

Table 6 LULC percentage of 2005, 2015 &2025

Land use	2005	2015	2025
Agriculture	51%	45%	36%
Barren Land	23%	20%	15%
Built Up	18%	30%	41%
Water Body	8%	5%	8%
Grand Total	100%	100%	100%

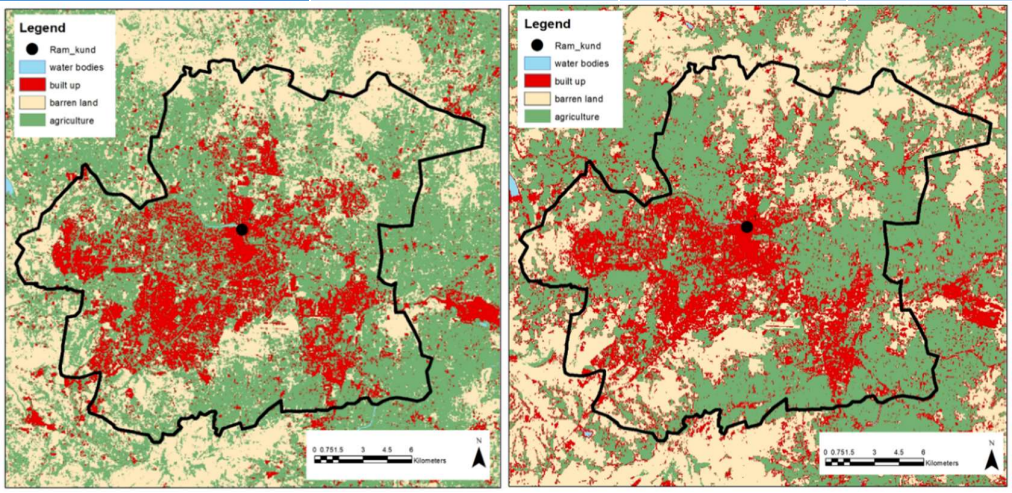


Figure 15 LULC 2005 and 2015

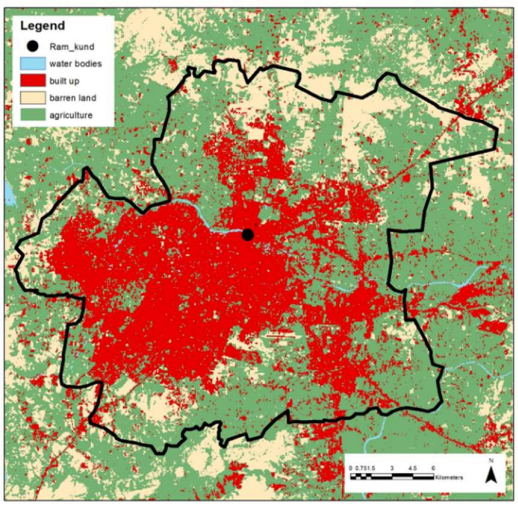


Figure 16 LULC 2025

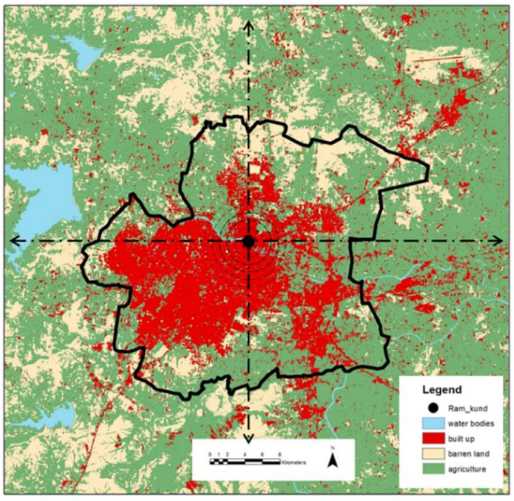


Figure 17 Direction of growth of city

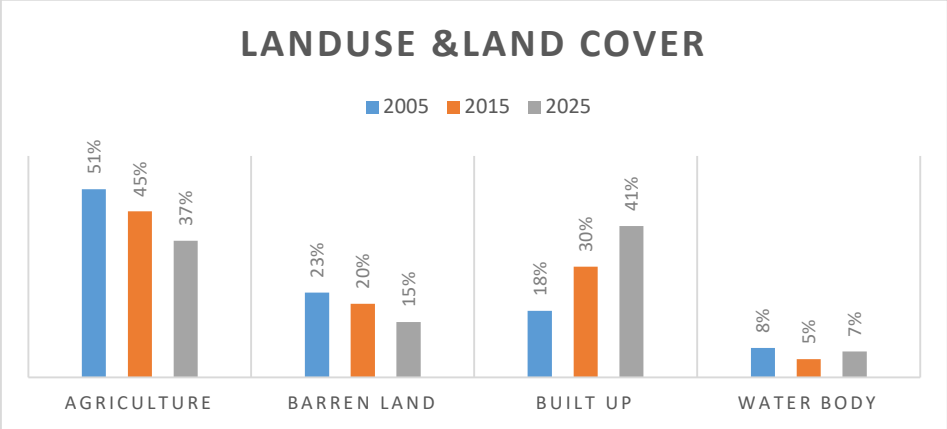


Figure 18 Land use & Land cover percentage

The analysis of land use and land cover changes in Nashik city over the years 2005, 2015, and 2025 reveals significant shifts in land utilization patterns. Agricultural land, which covered approximately 51% of the area in 2005, declined to 45% in 2015 and further reduced to 37% by 2025. This continuous decrease indicates a clear trend of agricultural land being converted for other uses, primarily due to urban expansion and infrastructure development.

Built-up areas have increased notably, rising from 18% in 2005 to 30% in 2015, and reaching 41% in 2025. This growth reflects the city's rapid urbanization and the increasing demand for residential, commercial, and institutional spaces. Barren land has gradually decreased, from 2.3% in 2005 to 2.0% in 2015 and 1.5% in 2025, suggesting that previously unused or underused land is being repurposed. Water bodies have shown minor fluctuations, with coverage decreasing from 8% in 2005 to 5% in 2015, then increasing slightly to 7% in 2025. This change may result from water management interventions or natural variability.

3.3.2 Demographics:

Covering an area of approximately 267 square kilometres, had a recorded population of 1,486,053 as per the 2011 Census (Nashik Draft development plan 2016-2036). By 2025, this number is estimated to rise significantly to around 2,110,197, reflecting rapid urban growth. In addition to its resident population, the city witnesses a substantial floating population of 1,00,000. And this number exponentially increases to 10,00,000 during Kumbh Mela.

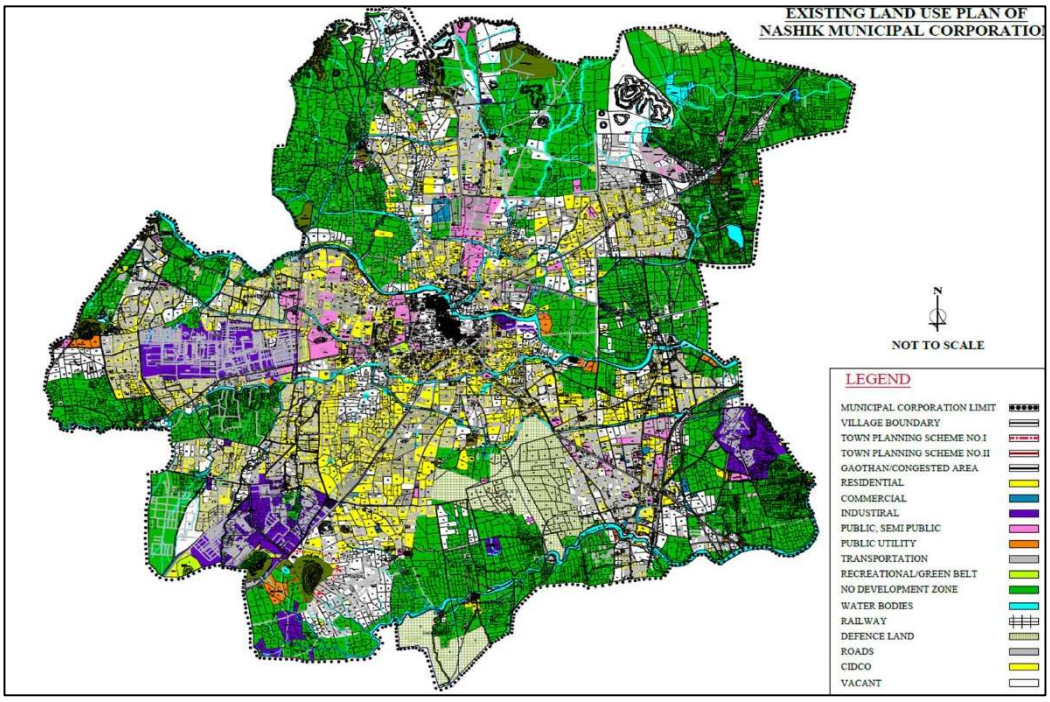


Figure 19 Existing land use of Nashik Municipal Corporation

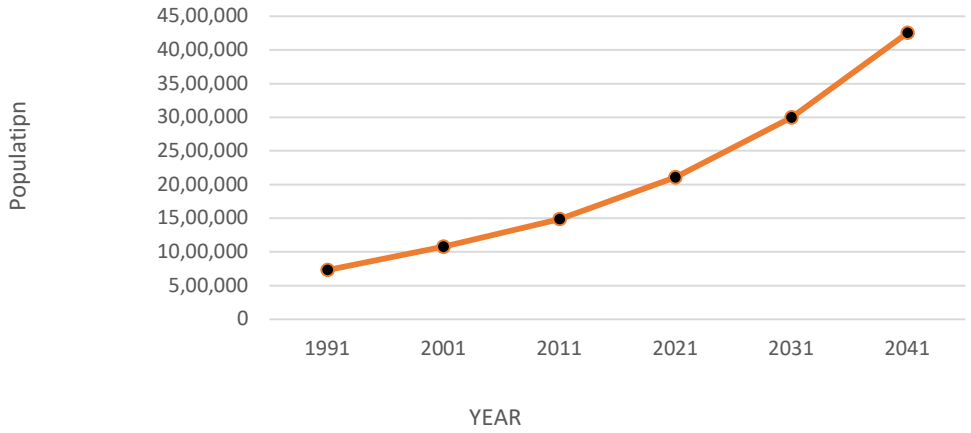


Figure 20: Population growth

Table 7 Population growth trend

NASHIK	
Year	**Popluation**
1991	7,33,000
2001	10,77,236
2011 (census)	14,86,053
2021 (projected)	21,10,197
2031 (projected)	29,96,477
2041 (projected)	42,54,998

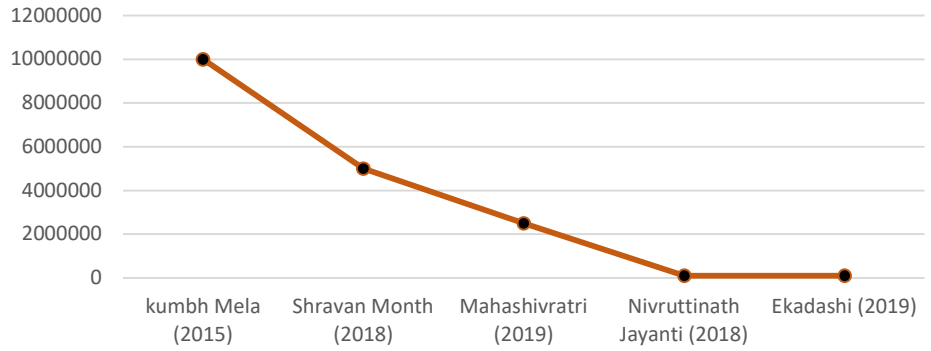


Figure 21: Floating Population During festival

Table 8 Pilgrims inflow

Important Festivals	Months	Devotees Inflow
kumbh Mela (2015)	July	10 Million
Shravan Month (2018)	August	50 Lakh
Mahashivratri (2019)	February	25 Lakh
Nivruttinath Jayanti (2018)	July	1 Lakh
Ekadashi (2019)	January	1 Lakh (above)

Source: Nashik Draft development plan 2016 -2036

3.3.3 Religious Tourism Circuit

he religious-cultural cosmos of Nashik is intricately woven around a ~2 km sacred riverfront stretch popularly known as the Goda Ghat or Godavari Ghat. This zone forms the spiritual nucleus of the city, where the ancient flow of the Godavari River becomes the lifeline of ritualistic, mythological, and communal activities. Anchored by revered pilgrimage landmarks such as Ramkund, Kalaram Mandir, Kapaleshwar Temple, Swami Narayan Temple, and the storied precincts of Panchavati, this linear corridor embodies centuries of faith and tradition.

Each of these sites holds deep associations with the Ramayana and other Hindu scriptures, establishing Nashik as a city of immense religious importance. The ghat transforms into a vibrant pilgrimage arena every 12 years during the Kumbh Mela, one of the largest spiritual congregations in the world. During this time, the riverfront witnesses a profound spatial and infrastructural shift—temporary settlements (like Sadhugrams), enhanced civic amenities, and ritual-specific arrangements emerge to support the influx of millions of devotees.

Beyond the Kumbh, this sacred stretch continues to serve as a site of daily religious practice, cremation rituals, holy dips, and temple visits—making it a living landscape of devotion. The Goda Ghat circuit not only defines Nashik's spiritual geography but also reinforces its identity as a historic pilgrimage city, where ecology, mythology, and urban life converge.

Figure 22 Socio- Religious tourism circuit

3.3.4 Water systems & drainage

The Nashik Municipal Corporation (NMC) relies heavily on surface water sources, with a network of rivers playing a crucial role in meeting the city's water needs. The city currently lacks a complete storm water drainage infrastructure. The land slopes are severe in some parts (Panchavati region), particularly near Godavari and its tributaries. The average low-lying ground level is 569 metres, with the highest ground elevation being 700 metres. The old city is located in low-lying parts, whilst the built districts are primarily on higher level. There are three major river basins in the company area, listed below. (Nashik ESR, 2023)

1. The Godavari River flows from west to east through the city's center section, covering around 18 kilometers. Approximately 8 nallas reach the river Godavari at this region.

2. The Nasardi River travels from west to east and enters the Godavari on the south bank at Takali. The Godavari River, the most sacred, flows through the central part of the city, serving as a lifeline for domestic and religious activities.

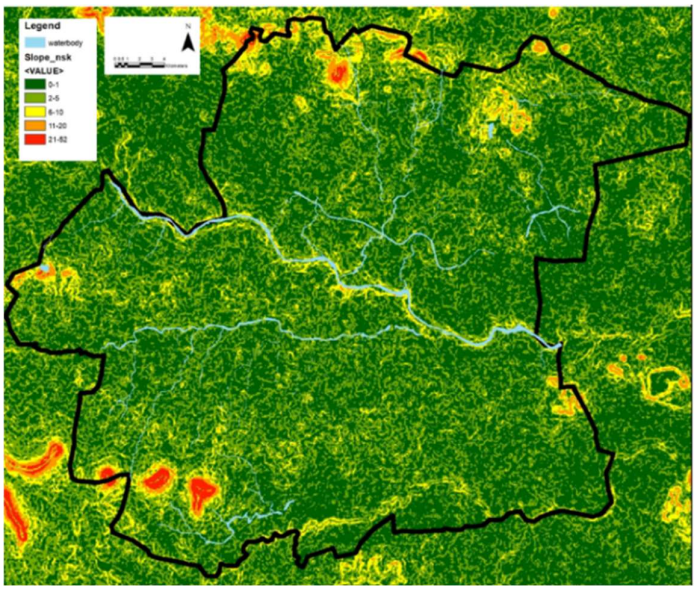


Figure 23 Slope map

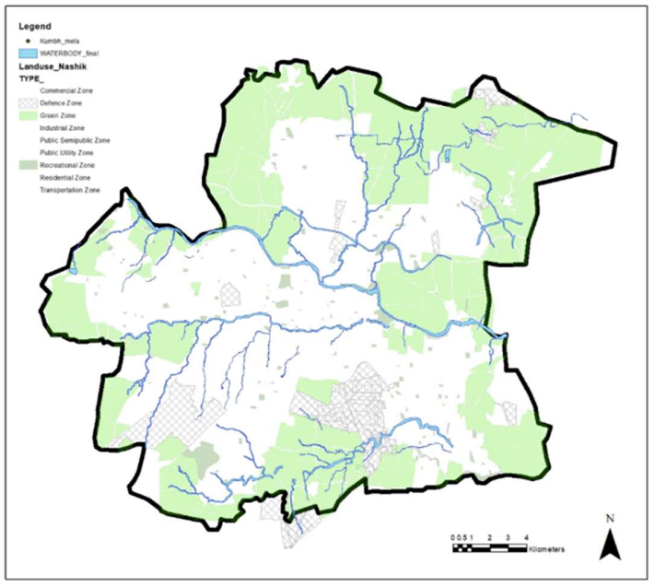


Figure 24 Water Bodies in Nashik city

4. The river Darana runs along the southeastern edge of NMC. Its tributary, Waldevi, flows from the northwest to the southeast and joins Darana near Chehedi.

The net domestic water demand is 170 lpcd, primarily used for household purposes, while the floating population—comprising pilgrims and tourists—requires an additional 50 lpcd. Given Nashik's significance as a religious and cultural center, especially during large-scale events like Kumbh Mela, this seasonal influx imposes a considerable strain on the city's water infrastructure, highlighting the need for adaptive and resilient water management strategies. (Nashik CDP, 2016).

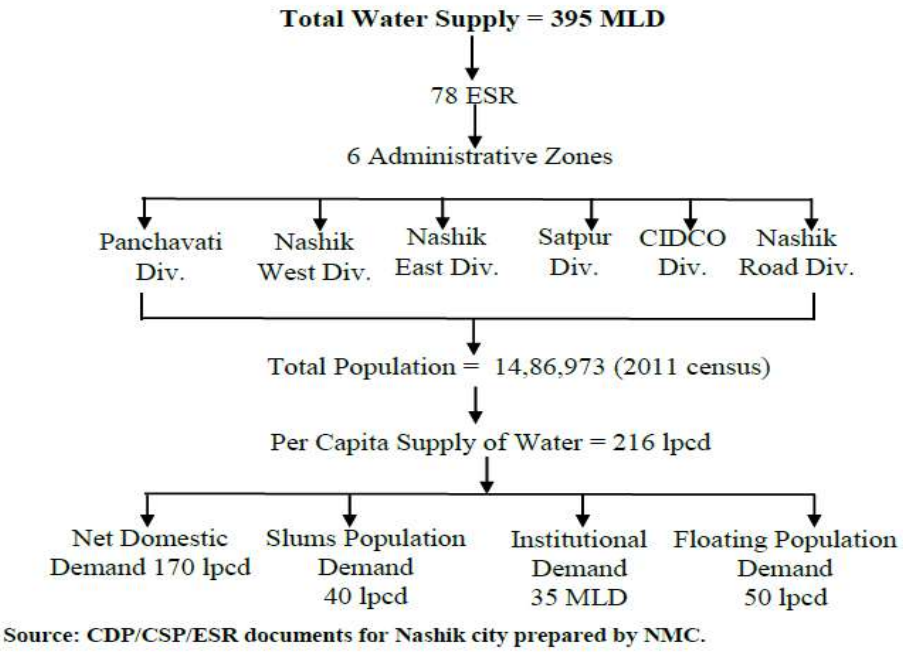

Total Water Supply = 395 MLD
78 ESR
6 Administrative Zones
Panchavati Div.
Nashik West Div.
Nashik East Div.
Satpur Div.
CIDCO Div.
Nashik Road Div.
Total Population = 14,86,973 (2011 census)
Per Capita Supply of Water = 216 lpcd
Net Domestic Demand 170 lpcd
Slums Population Demand 40 lpcd
Institutional Demand 35 MLD
Floating Population Demand 50 lpcd
Source: CDP/CSP/ESR documents for Nashik city prepared by NMC.

Figure 25 Water supply demand of NMC

The aquifers I has Depth of occurrence (mbgl) of basalt is 9 to 10 mbgl, and the fractured rock thickness varies between 8 to 10 m range. The depth of aquifer II is 30 to 60 mbgl, and the fractured rock thickness varies between 1 to 3 m range. Pre monsoon the water level of aquifer I is 5 to 10 mbgl and post monsoon it is 2 to 5 mbgl. For aquifer II the depth of groundwater is below 20mbgl post monsoon the water levels are about 5 to 10 mbgl. (Aquifer maps and ground water management plan nashik district, maharashtra aap 2021-22).

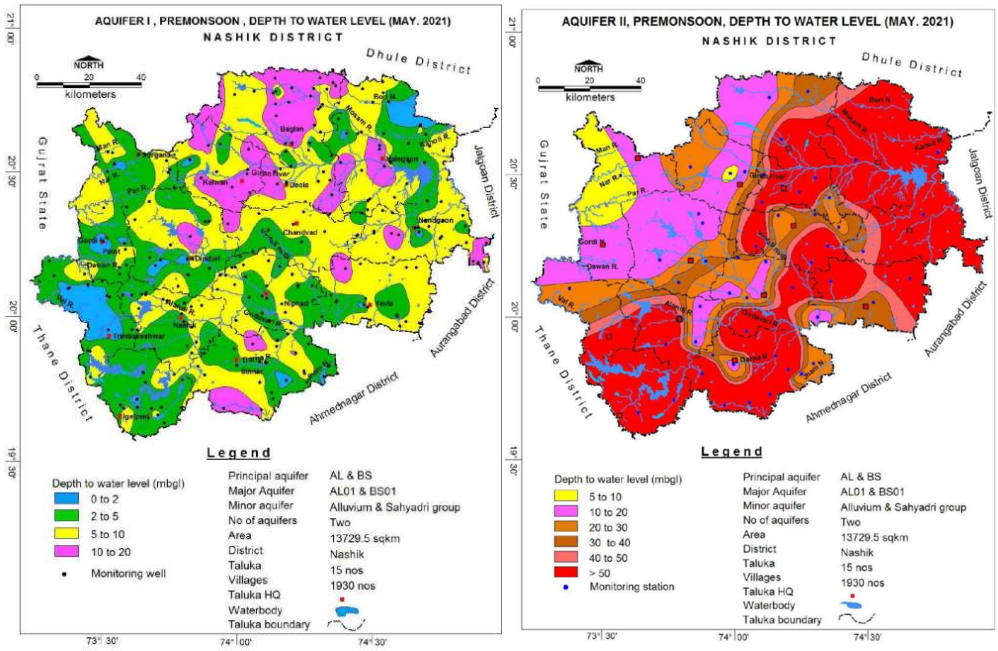


Figure 26 Pre monsoon depth to water level of aquifer I and II

Table 9existing and Proposed Sewage Treatment plants

Existing and Proposed Sewage Treatment Plants						
Location	Existing Capacity (MLD)	Capacity as per Package-I	Capacity as per Package-II For 2026	Capacity of Proposed STP (MLD)		
				For 2026	For 2041	Total capacity in 2041
Tapovan	130.00	-	-	-	9.00	139.00
Makhamalabad	-	-	-	27.00	18.00	45.00
Agartakli	70.00	70.00	40.00	-	67.00	177.00
Chehedi	42.00	-	-	-	28.00	70.00
Panchak	28.50	-	32.00	-	43.0	103.50
Kamtwada	-	-	-	36.00	18.00	54.00
Pimpalgaon Khamb	-	-	-	32.00	22.50	54.50
Gangapur	-	-	18.00	-	10.50	28.50
Total	270.50	70.00	90.00	95.00	216.00	671.50

Source - NMC

By the year 2041, Nashik's sewage generation is projected to reach approximately 638 million litres per day (MLD), based on the anticipated population of over 42.5 lakh and standard per capita sewage generation estimates. In comparison, the total sewage treatment capacity planned across various locations in the city is estimated to be 671.5 MLD, as per the proposed and existing STPs outlined by the Nashik Municipal Corporation (NMC). This indicates that the city's sewage treatment infrastructure, if implemented as planned, will be adequate to handle the projected sewage load for

2041. Therefore, no immediate need for additional STPs is foreseen, although future provisions should account for urban expansion, potential treatment inefficiencies, and resilience planning to ensure long-term sustainability.

3.4 Data Collection & processing

To determine the locals' perceptions, a structured questionnaire survey was conducted. The survey aimed to gauge their perception regarding the availability of water, their participation in the activities of water conservation, and their perception concerning water issues, particularly during peak pilgrimage periods, on a five-point Likert scale with 1 being the most negative perspective and 5 being the most positive.

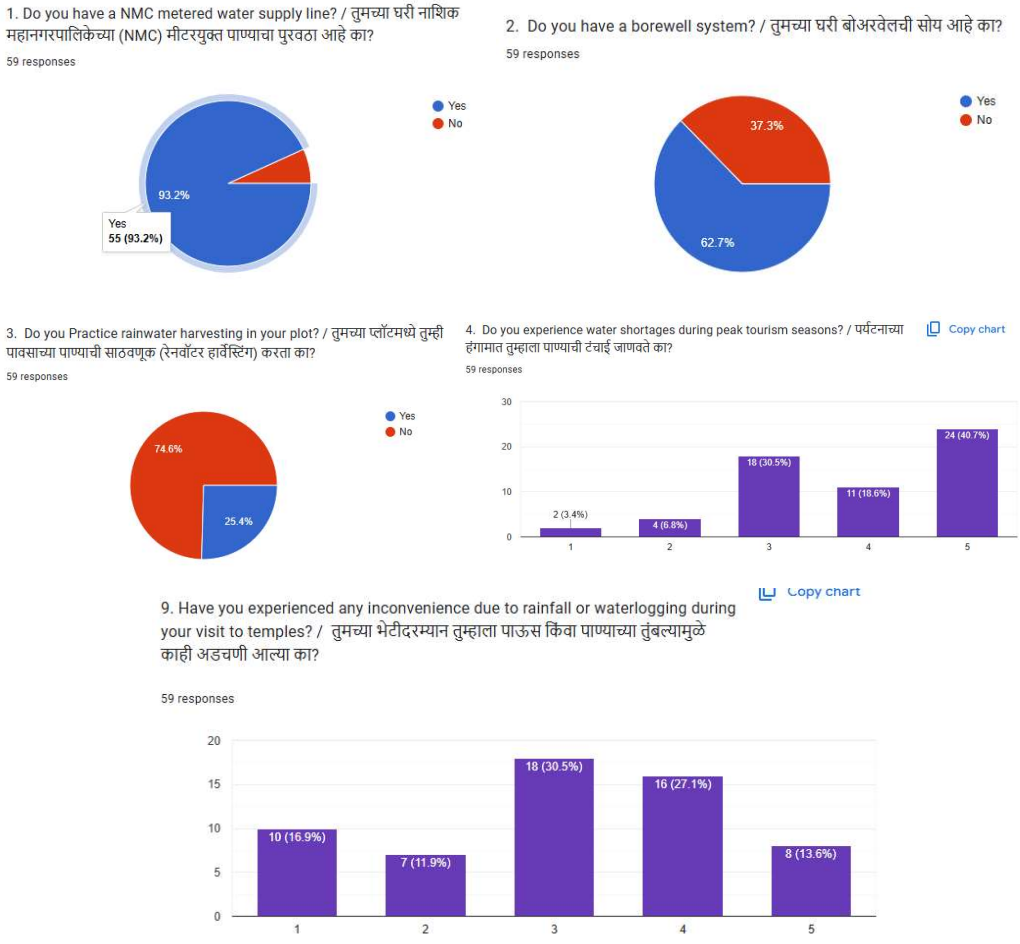


Figure 27 Survey Question for the existing water system in the city

The survey findings reveal that while a majority of respondents (93.2%) in Nashik rely on the NMC's metered water supply, over 62% also depend on borewell systems,

indicating a dual reliance likely driven by inconsistent municipal supply. Despite this, only 25.4% practice rainwater harvesting, suggesting underutilization of sustainable water practices. Water scarcity during peak tourism seasons is a significant issue, with 71% reporting moderate to severe shortages, reflecting the strain on resources during festivals and pilgrim influx. Additionally, 71.2% of respondents indicated they have faced inconvenience due to rainfall or waterlogging during temple visits, pointing to inadequate stormwater infrastructure. These insights highlight the urgent need for integrated water management strategies, including improved rainwater harvesting, better drainage systems, and enhanced supply resilience to accommodate both resident and floating populations.

Due to the limitations in conducting direct surveys with tourists, tourist perceptions were collected from secondary data sources, which predominantly consisted of research articles and academic journals. These sources provided an in-depth understanding of tourists' attitudes, behaviors, and experiences regarding water use and infrastructure in Nashik.

Table 10 Tourist Characteristics

Characteristics of Responders	Category	Kalaram Mandir (%)	Panchvati (%)
Nationality	Indian	97.4	86.6
	Other	2.6	13.4
Native State	Maharashtra	78	83.5
	Other	22	16.5
If from Maharashtra	Nashik	41.1	62.8
	Other	58.9	37.2

Source: (Pagare & Gajhans, n.d.)

Table 11 Tourist Indicator

Indicator	Variable	Kalaram Mandir (%)	Panchvati (%)
No. of Persons Accompanied	Less than 5	33.6	29.36
	5–10	52.3	66.46
	Above 10	14.1	4.1
Duration of Visit	Less than 24 hours	89.66	74.85
	24–72 hours	8.23	21.33
	More than 72 hours	2.11	3.82
Distance Travelled	Less than 50 km	6.53	13.64
	50–100 km	21.67	21.63
	100–200 km	29.59	35.1

	More than 200 km	42.21	29.63
Mode of Travel	Own Vehicle	45.54	67.98
	Public Transport	54.46	32.02
Visit Frequency	First Time	39.52	21.34
	Second Time	22.3	28.33
	Third Time	20.14	24.63
	Fourth or More	18.04	25.7

Source: (Pagare & Gajhans, 2020)

The comparative analysis of Kala Ram Mandir and Panchvati, from the research paper, reveals that both temple sites are predominantly visited by Indian nationals, mostly from Maharashtra, with a particularly strong representation from Nashik district—especially at Panchvati. Visitors to Panchvati tend to arrive in larger groups, whereas Kala Ram Mandir sees a mix of group sizes. Both locations primarily host short-duration visits of less than 24 hours, indicating that they are typically included in brief pilgrimage circuits or day trips. (Pagare & Gajhans, 2020)

4 Chapter 4: Parameters & Tools

Parameters and Sub-Parameters

Considering findings from the phase 1 study of the project, and proceeding rto devise a framework reffering to the extensive literature review, case studies, and selction processof the study area, the result yielded the identification of 31 sub parameters and 10 major parameters.

Table 12 Parameters & Sub-parameters derived from the study

Sr. no.	Parameters	Sub-Parameters		Data Sources
1	**Religio - cultural significance**	1	Reiligio cultural association with river bank/ ghats	primary source
		2	Reiligio cultural association with kunds and ponds	primary source
		3	footfall of more than 100 people/day	P. A. Pagare & Dr. D. S. Gajhans 2020
		4	listed as an attraction spot on travel-related websites	primary source
		5	good waste management facilities	CDP Report
2	**Waterscape Protection and Dynamics**	6	Floodplain boundaries clearly demarcated	CDP Report
		7	Edge erosion/ profile protected through embankments, roads, or other means	Primary survey, spatial data mapping
		8	Presence of river buffer landscaping	Primary survey
		9	development in adjacent to the water body or river in the active floodplain	CDP Report
		10	Strict enforcement in no development zone	Primary survey
		11	water body buffer	URMP framework
3	**Rainfall and Stormwater**	12	Annual precipitation	CDP report
		13	Drainage patterns and soil infiltration rates	gis analysis/reports
4	**Surface water quantity & dynamics**	14	Surface water area and distribution	URDPFI guidelines, 2014
		15	Obstruction in the river's natural course due to development project	gis analysis /reports

5	**Surface Water Quality and pollution levels**	16	Sedimentation and water bed health	ESR Nashik
		17	Physico-chemical properties of surface water	ground water report
		18	physico-chemical properties of surface water After festival	ground water report
6	**Groundwater Level**	19	Seasonal changes in Water Table level	ground water report
		20	Chemical properties of ground water	ground water report
		21	Ground water extraction (boring, etc.)	Primary survey
7	**Rainwater Harvesting and Catchment Areas**	22	Existing RWH infrastructure and effectiveness	UDCPR Guidelines
		23	Profile of Storm Water Drain	ESR Nashik
		24	Identification of natural and artificial catchment zones	water shed analysis
8	**Water Supply and Demand**	25	Current water consumption rates and sources	CDP report
		26	Current water consumption rates and sources during heavy cyclic religious activites	CDP report
9	**Waste management**	27	Solid waste (D2D collection)	https://www.pcmcindia.gov.in/marathi/swm2019/Final-GARBAGE%20FREE%20CITIES%20Flyer.pdf
		28	solid waste proximity to landfill	gis mapping
		29	sewage	city sanitaion plan
		30	Water reuse	Waste water reuse of indian cities.- MOHUA 2020
10	**Biodiversity**	31	impact on flora & fauna of religious significance	ESR Nashik

5 Chapter 5: Data Analysis & Results

To effectively address tourism water-related issues, it's crucial to take into account multiple dimensions and aspects that provide a comprehensive understanding of the dynamics involved. The study's analysis delves into how different water typologies are distinguished from one another and how the nexus network, which relates to the flow of water, is maintained within or in proximity to these typologies.

5.1 City-Level Contextual Assessment

5.1.1 Overview of Tourism and Pilgrimage Activity

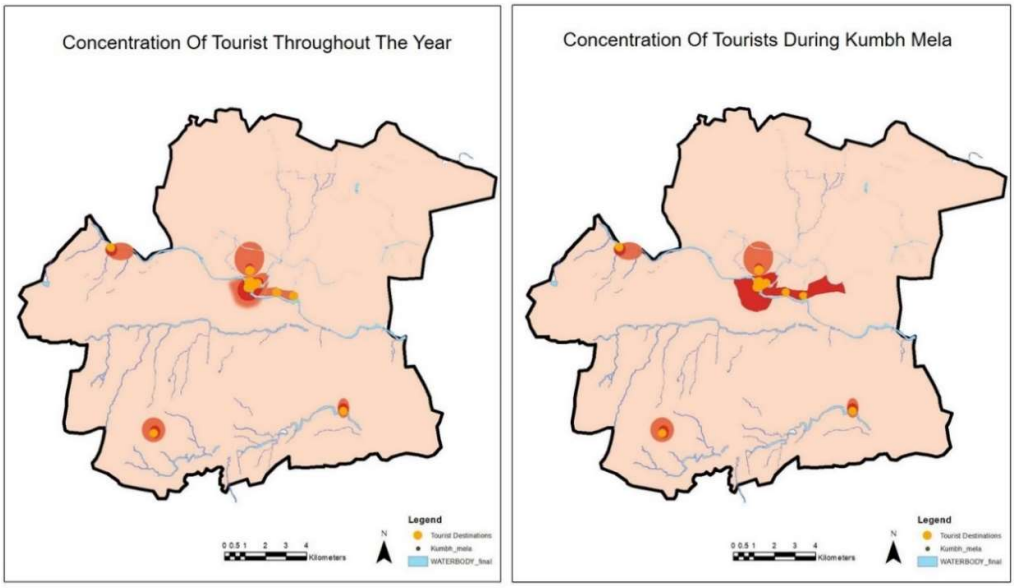


Figure 28: Concentration of tourists annually v/s during Kumbh Mela

The maps illustrate the spatial concentration of tourists in Ujjain both annually and during the Kumbh Mela. While tourist activity is moderately spread throughout the year, the Kumbh Mela causes an intense surge, particularly along the Kshipra River and temple precincts. This sharp seasonal variation highlights the need for event-specific infrastructure planning and crowd management.

Major festivals such as Ganesh Chaturthi, Diwali, and Ashadhi Ekadashi are spread across different months, bringing a significant influx of devotees during these periods. The peak months of religious activity appear to be March, July, and October-November, with events like Holi, Shravan Somvar, Dussehra, and Diwali spanning several days. This dense and periodic festive calendar underscores Nashik's importance as a

pilgrimage destination, contributing to seasonal spikes in population, water usage, waste generation, and pressure on public infrastructure.

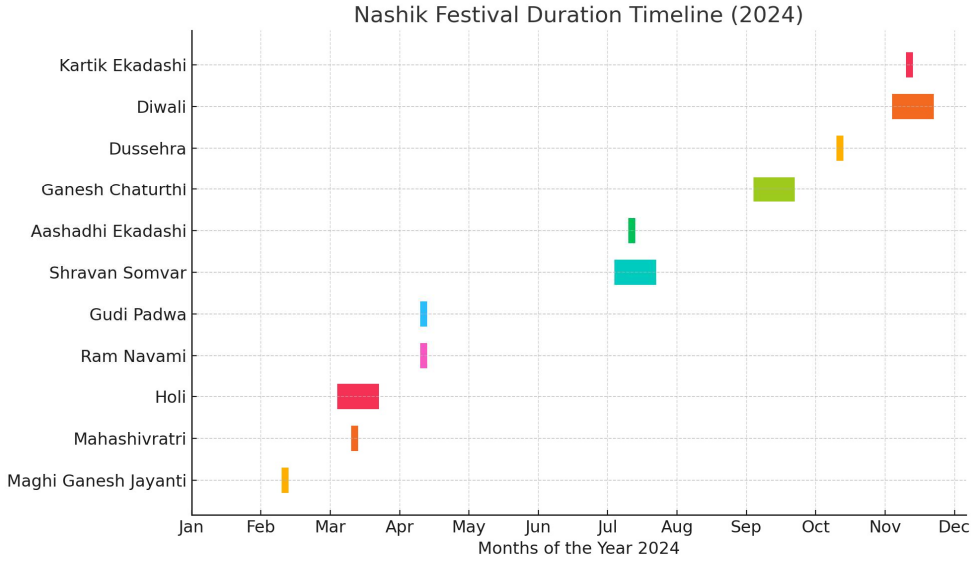


Figure 29 Festive Timeline 2024

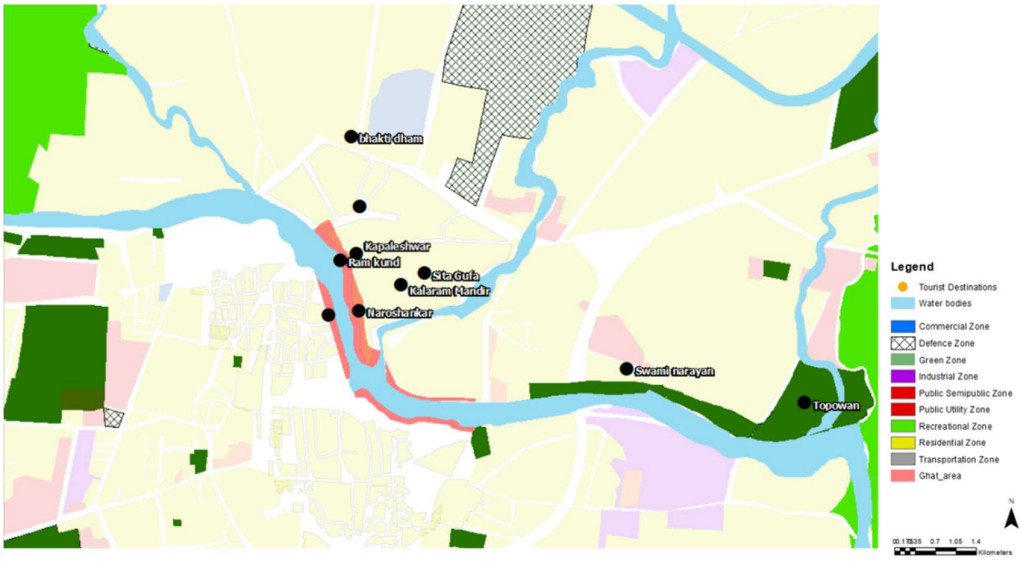


Figure 30 Religious Places in the cold city area

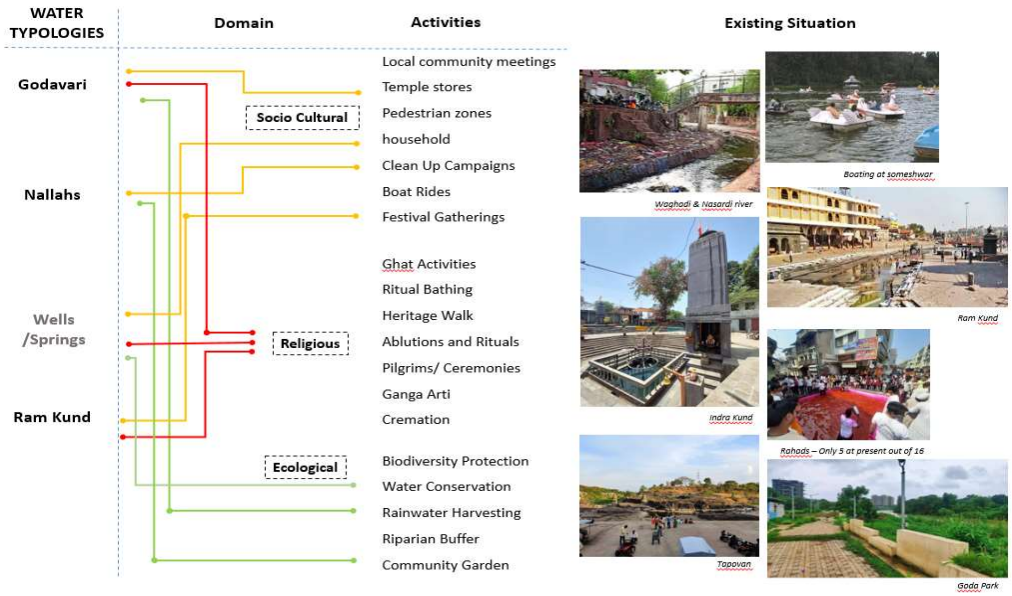


Figure 31 Water and the associated actives within the religio- socio cultural & ecological domain

5.1.2 Riparian Zone

To uphold these massive activities, the ancient kunds such as Ramgaya Kund and Ramgaya Tirtha, once deeply connected to the Ramayana and local traditions, have gradually lost their cultural and functional significance. Originally serving as important water sources and spiritual landmarks, these ponds have now been either merged with other structures or concretized, rendering them impermeable. This transformation has not only disrupted their role in groundwater recharge but also contributed to the erosion of Nashik's water heritage and cultural memory.

Figure 32 Concretized cosmic stretch of the river

Figure 33 pre-monsoon and post monsoon condition of Ram kund due to anthropogenic activities

The 100-meter buffer around the Godavari River, as shown in the figure , highlights the critical interaction zone between surface and subsurface hydrology. Despite seasonal drying of the Ram Kund, several adjacent kunds and perennial springs within this buffer retain groundwater, indicating areas of high recharge potential and hydro-ecological sensitivity. These natural features suggest the presence of subsurface aquifers that remain active year-round due to proximity to the river channel, unpaved surfaces, and limited impermeable development in certain patches. Recognizing and protecting this buffer zone is essential not only for groundwater conservation, but also for maintaining the spiritual and cultural continuity of pilgrimage-linked water bodies.

Uma Kund, a perennial spring of water in Devang Jani's ancestral house, just 100 meters from Ramkund Photo: Parineta Dandekar

Figure 34 Uma kund, a perennial spring source : parineta Dandekar

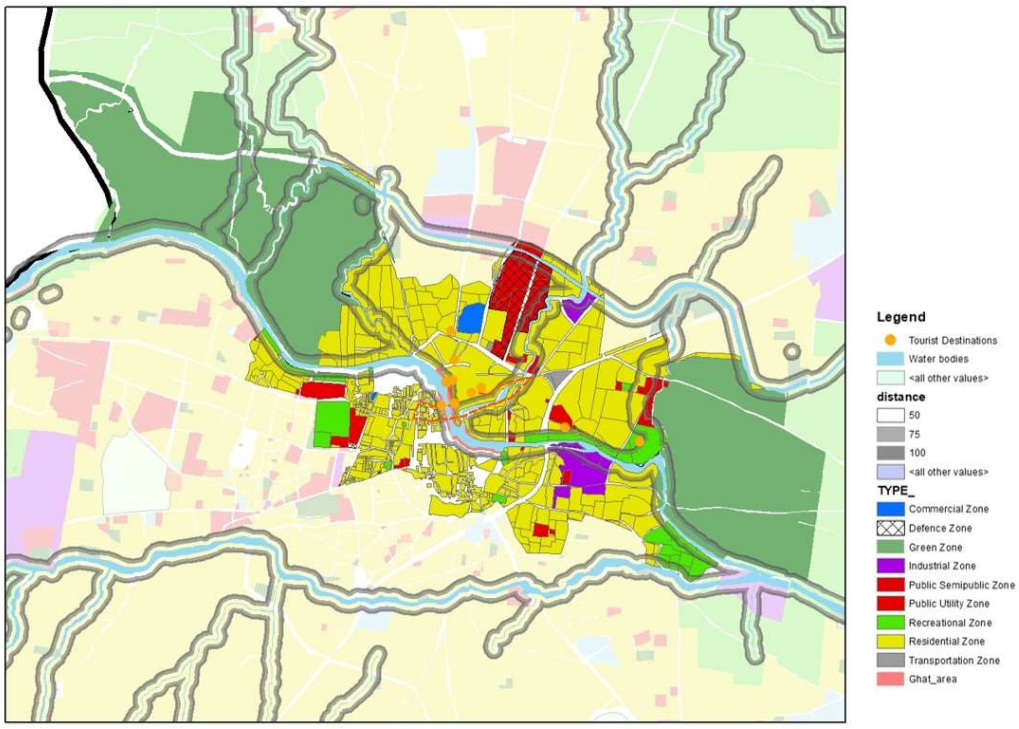


Figure 35 100 m Buffer around water bodies

The stretch along the river is most suidtable for recharge zone. But nashik has very intermidate level intervensions.

Riparian buffer factor = Total length of riparian buffer (within city limits)/
Total length of river edge in the city x 100
= (3.8 + 1.7 + 4.5)/ 18 X 100. = **30**

The evaluation of floodplain and riverbank conditions in Nashik reveals a partially protected yet highly vulnerable riparian system. The clear demarcation of floodplain boundaries (score:5) reflects a positive step towards planning and spatial regulation. However, the overall protection of the river edge is inconsistent. While some edge erosion is managed through embankments or infrastructure (score: 2), this measure is insufficient in ensuring continuous bank stability and ecological integrity. The presence of river buffer landscaping (score: 3) suggests moderate green infrastructure, yet the score of 1 for development within the active floodplain raises serious concerns about encroachments and built-up activity in ecologically sensitive zones. Furthermore, the poor enforcement in no-development zones (score: 1) points to gaps in institutional

monitoring and regulatory implementation. Although water body buffers exist to some extent (score: 3), their limited scope reduces their effectiveness in protecting the river from urban runoff and anthropogenic pressures. This pattern indicates an urgent need for strengthened regulatory enforcement, expansion of green buffers, and reclamation of encroached floodplain areas, particularly in high-risk zones like the religious core.

5.1.3 Groundwater Potential Mapping

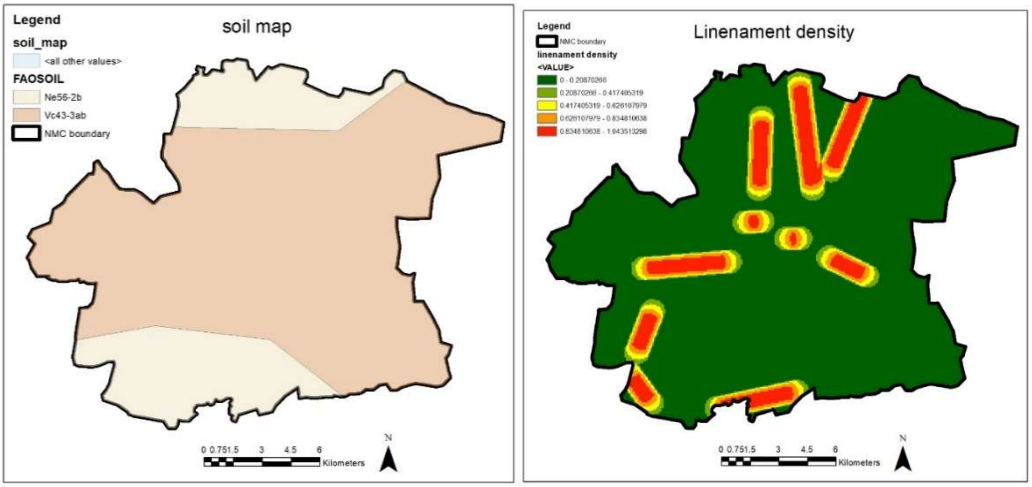


Figure 36 Soil & linenament density map

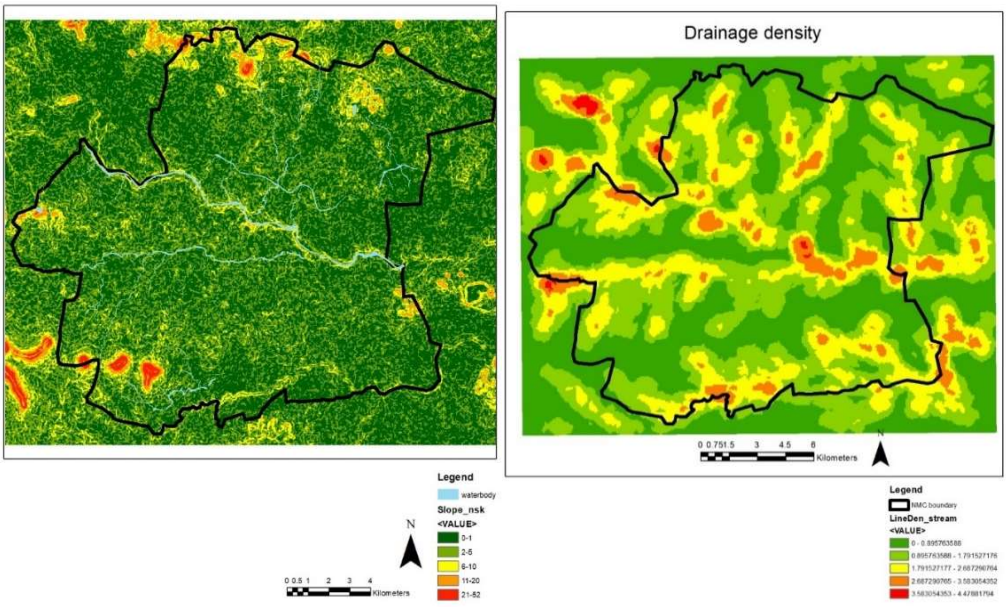


Figure 37 Slope and Drainage density map

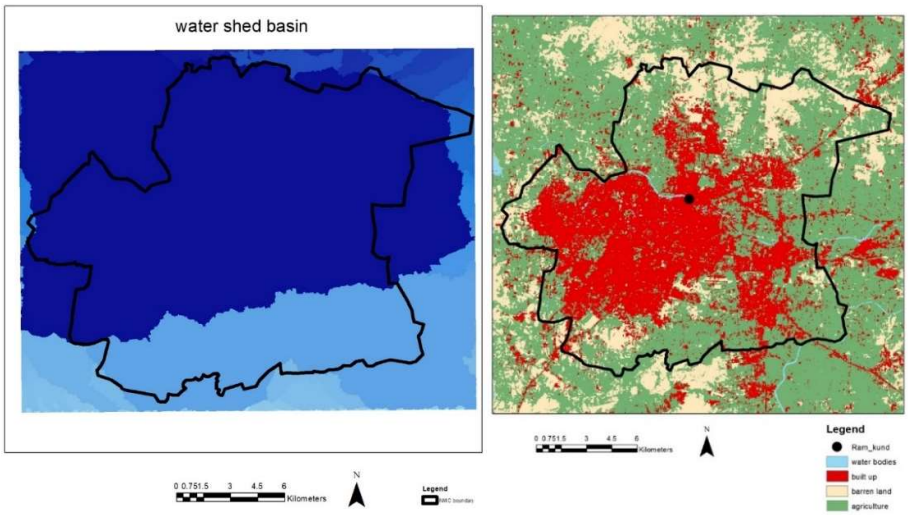


Figure 38 watershed analysis and LULC 2025 map

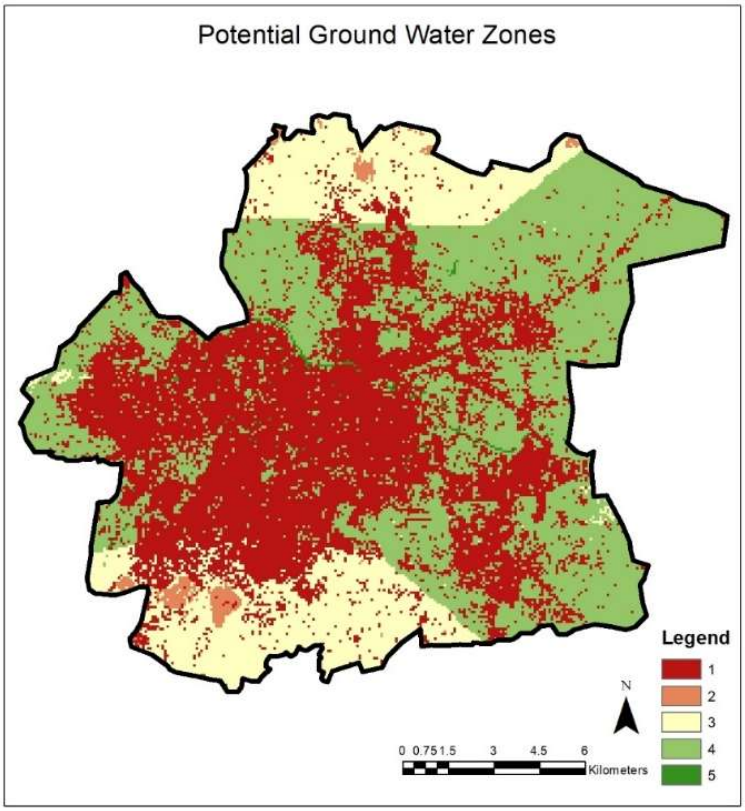


Figure 39 Potential areas of ground water recharge

Table 13 Weightage of map for overlay analysis

Map	weightage
Soil map	25%
Water shed	10%
LULC	25%
Drainage delination	15%
Slope map	20%
Lineament density	5%

5.1.4 Sewage and Drainage Infrastructure:

Wards 1, 2, 8, 10, 11, 12, and 13 still discharge sewage through open drains, contributing to significant environmental and public health concerns. Among these, Ward 10 accounts for the highest share, with approximately 30% of its sewage directly released into open drainage systems. (City Sanitation Plan for Nashik, 2016)

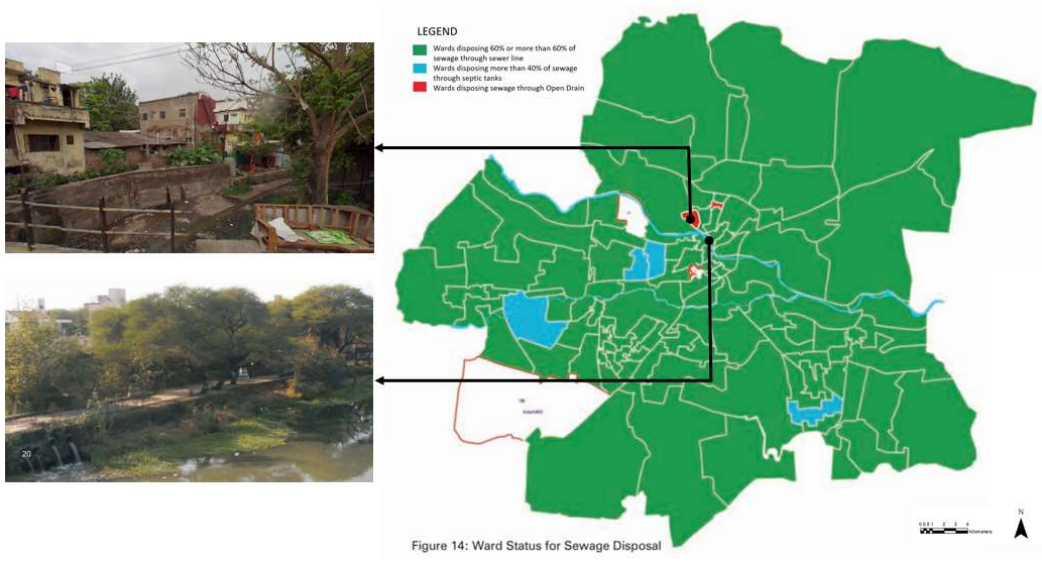

LEGEND
Wards disposing 60% or more than 60% of sewage through sewer line
Wards disposing more than 40% of sewage through septic tanks
Wards disposing sewage through Open Drain
Figure 14: Ward Status for Sewage Disposal

Figure 40 Ward status for sewage disposal

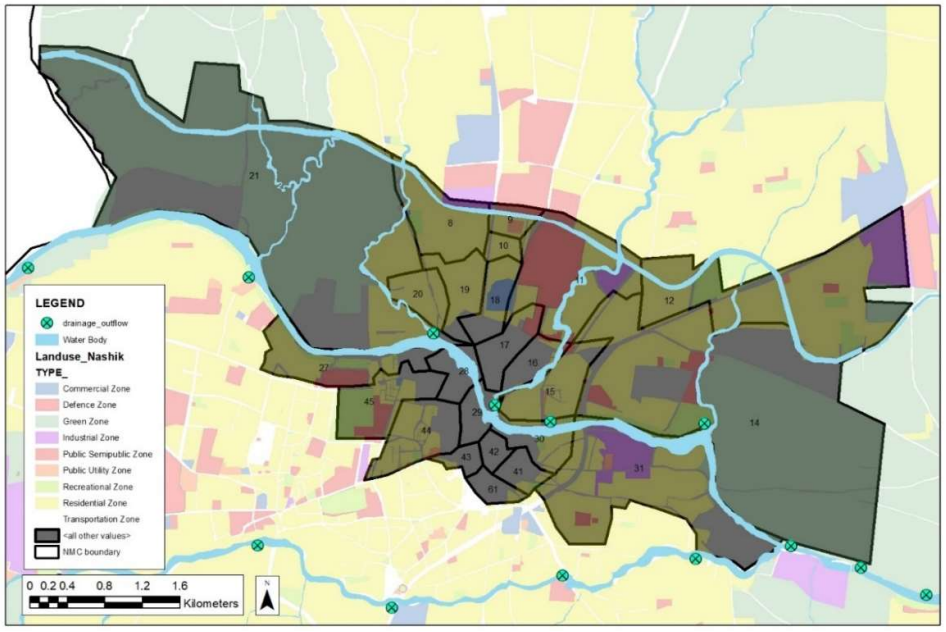


Figure 41 Effluent points

During heavy rainfall events, the existing drainage infrastructure fails to manage the increased runoff, leading to the direct discharge of untreated domestic and agricultural

waste into the river. These open drains, functioning as informal sewers, carry wastewater from surrounding areas and ultimately converge at Ram Kund. This unregulated flow not only causes severe pollution of the Godavari River but also poses risks to public health and undermines the sanctity of the water body, disrupting the pilgrimage activities.

Net DO =DO outlet – DO inlet /

DO inlet x 100 where DOoutlet = DO at outlet; DOinlet = DO at inlet

(5.5-7.3)/ 7.3 X 100 = **-24.65**

5.2 Data analysis

Table 8 presents a Scoring Parameter Index used for assessing environmental and ecological health based on specific indicators. The scoring scale is color-coded from 1 to 5: (Red) – Poor/Negative Impact; 2 (Orange) – Medium Impact; 3 (Yellow) – Medium-Good; 4 (Light Green) – Good 5 (Dark Green) – Exceptional/Positive Impact. The index serves as a comprehensive tool for environmental monitoring and decision-making, allowing for standardized assessment across different parameters.

Table 14 Cumulative parameters and ratings

Sr.No.	Parameters	Sub-Parameters	Range					Scoring	
III.	Impact of Tourism on Water and Water Management		1	2	3	4	5		
1	Religio -cultural significance	1 Religio cultural association with river bank/ ghats	Negect	Poor	Medium	Good	Exceptional	4	primary source
	2 Religio cultural association with kunds and ponds		Negect	Poor	Medium	Good	Exceptional	4	primary source
	3 footfall of more than 100 people/day		Negect	Poor	Medium	Good	Exceptional	4	
	4 listed as an attraction spot on naval-related websites		Negect	Poor	Medium	Good	Exceptional	5	
	5 Waste management facilities		Negect	Poor	Medium	Good	Exceptional	2	
2	Waterscape Protection and Dynamics	6 Floodplain boundaries clearly demarcated	Negect	Poor	Medium	Good	Exceptional	5	CDP Report
	7 Edge erosion/ profile protected through embankments, roads, or other means		Negect	Poor	Medium	Good	Exceptional	2	Primary survey, spatial data mapping
	8 Presence of riverbuffer landscaping		Negect	Poor	Medium	Good	Exceptional	1	Primary survey
	9 development in adjacent to the water body or river in the active floodplain		Negect	Poor	Medium	Good	Exceptional	1	CDP Report
	10 Strict enforcement in no development zone		Negect	Poor	Medium	Good	Exceptional	1	Primary survey
	11 Waterbody buffer		<30	30- 49	50- 69	70- 89	90- 100	2	LRMP framework
3	Rainfall and Stormwater	12 Annual precipitation	<300mm	300mm-1200mm	1201mm-1500mm	1501mm-2000mm	>2000mm	3	CDP report
	13 Drainage patterns and soil infiltration rates		<5 mm/hr	6-10 mm/hr	11-15 mm/hr	16-20 mm/hr	>20 mm/hr	3	gis analysis /reports
4	Surface water quantity & dynamics	14 Surface water area and distribution	< 25%Extremely low surface water availability; inadequate for urban needs and ecosystem services.	25% - 50% below acceptable levels; limited access to surface water bodies, affecting quality of life.	50% - 75% Meets minimum standards; some access to surface water bodies and ponds, but still insufficient for sustainability.	100% - 150% Good coverage; adequate surface water bodies contributing to urban ecology and recreation.	> 150% Optimal surface water availability; supports biodiversity, recreation, and effective stormwater management.	2	LRMP Guidelines, 2014
		15 Obstruction in the rivers natural course due to development project	Negect	Poor	Medium	Good	Exceptional	2	
5	Surface Water Quality and pollution levels	16 Sedimentation and waterbed health	Negect	Poor	Medium	Good	Exceptional	2	EIA Nashik
	17 Physico-chemical properties of surface water		Net DO <- (minus)10	Net DO = minus) - 10 - (minus) - 5.1	Net DO = (minus) - 5 - <0	Net DO = 0	Net DO > 0	1	LRMP framework
	18 physico-chemical properties of surface water After festival		Net DO <- (minus)10	Net DO = minus) - 10 - (minus) - 5.1	Net DO = (minus) - 5 - <0	Net DO = 0	Net DO > 0	1	LRMP framework

Sr.No.	Parameters	Sub-Parameters		Range					Scoring	
				1	2	3	4	5		
III.	Impact of Tourism on Water and Water Management									
6	Groundwater Level	19	Seasonal changes in Water Table level	<4m fluctuation	<3m fluctuation	<2m fluctuation	<1m fluctuation	<0m fluctuation	2	ground water repor
		20	Chemical properties of ground water	0- 50 mg/l	51- 250 mg/l	251- 500 mg/l	501- 1000 mg/l	>1000 mg/l	3	ground water repor
		21	Ground water extraction (boring, etc.)						3	
7	Rainwater Harvesting and Catchment Areas	22	Existing RWH infrastructure and effectiveness	<10% coverage	<25% coverage	<50% coverage	<75% coverage	100% coverage	2	UDCPR Guidelines
		23	Profile of Storm Water Drain	Neglect	Poor	Medium	Good	Exceptional	2	ESR Nashik
		24	Identification of natural and artificial catchment zones	<20% identified	<40% identified	<60% identified	<80% identified	100% identified	3	water shed analysis
8	Water Supply and Demand	25	Current water consumption rates and sources	300L/day/person	250L/day/person	200L/day/person	150L/day/person	<100L day/person	4	CDP report
		26	Current water consumption rates and sources during heavy cyclic religious activites	300L/day/person	250L/day/person	200L/day/person	150L/day/person	<100L/day/person	2	
9	Waste management	27	solid waste (D2D collection)	<20 %	20%-40%	40%-60%	60%-80%	>80%	4	https://www.pcmcindia.gov.in/marathi/swm2019/Final-GARBAGE%20FREE%20CITIES%20Flyer.pdf
		28	solid waste proximity to landfill	0 - 1 km	1 - 3 km	3 - 5 km	5 - 10 km	>10 km	4	gis mapping
		29	sewage	<20 %	20%-40%	40%-60%	60%-80%	>80%	3	city sanitaion plan
		30	Water reuse	<20	20-39	40-59	60 -79	80-100	5	URMP framework
10	Biodiversity	31	impact on flora & fauna of religious significance	Neglect	Poor	Medium	Good	Exceptional	3	ESR Nashik

$$\text{URM index} = \frac{3.8 + 2 + 3 + 2.5 + 1.33 + 2.67 + 2.33 + 3 + 4 + 0.6}{10}$$

URM index= **2.6**

Table 15 Scoring range of URM index (source: URMP Framework)

URM index	Interpretation	What It Means
< 1.5	Poor level of urban river management	The city fails to meet basic criteria for effective river management. The river is neglected, with unmanaged waste, encroachments, and no planning for seasonal pressures such as tourism or pilgrimage.
1.6 – 2.5	Elementary level of urban river management	Some foundational efforts are visible, such as waste collection or riverbank clean-up. However, serious gaps remain in infrastructure, monitoring, and ecological preservation. Many dimensions are overlooked.
2.6 – 3.5	**Average level of urban river management**	The city has a moderately functional river management system. Policies may exist, and some infrastructure may be in place, but several dimensions—such as biodiversity conservation, stormwater handling, or integration with tourism—still need attention.
3.6 – 4.5	High level of urban river management	The city performs well on most river management fronts. While minor imbalances or gaps may exist between components (e.g., between pollution control and ecological restoration), overall planning is effective.
4.6 – 5.0	Ideal level of urban river management	The city exemplifies best practices across all dimensions of river management—policy, infrastructure, ecology, and community engagement. Actions are proactive, integrated, and sustainable even under stressors like tourism.

The above table 13 is made with reference to URMP framework and tailored for cities with temple towns. Nashik, demonstrates an average level of urban river management, indicating that while foundational systems and policies are in place, several critical dimensions still require significant improvement. Existing infrastructure may be handling core functions like sewage treatment and basic waste management, but challenges remain in areas such as ecological restoration, stormwater management, solid waste overflow during peak pilgrimage periods, and integration of cultural tourism with river conservation. To progress toward a higher level of urban river management, a more holistic and river-sensitive planning approach is needed—one that integrates environmental, cultural, and infrastructural considerations. Emphasis must be placed on restoring natural hydrological functions, improving community

participation, and strengthening policy enforcement, especially in the context of periodic pilgrimage pressures like the Kumbh Mela.

5.3 Identification of affected wards

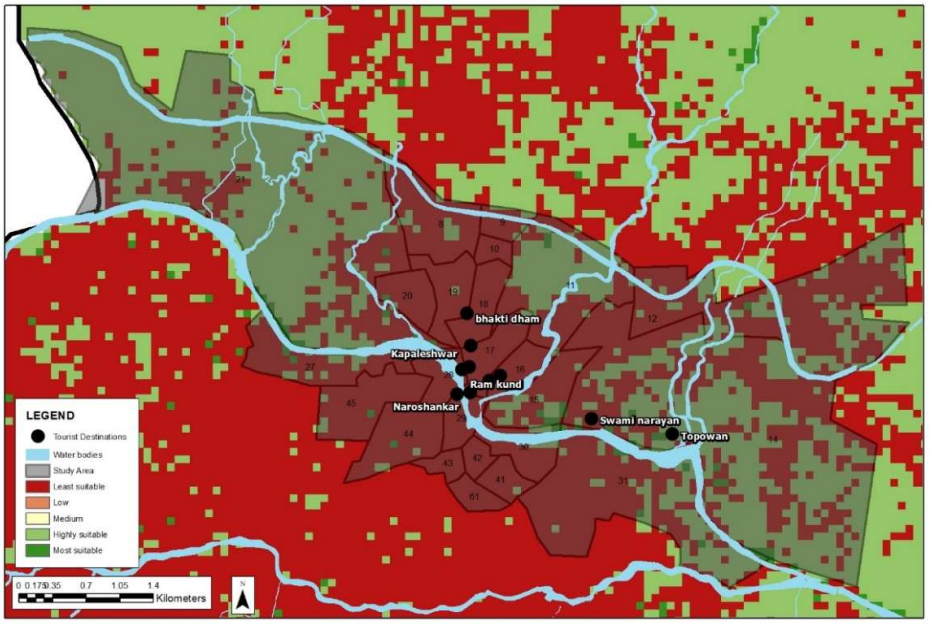


Figure 42 potential areas of infiltration

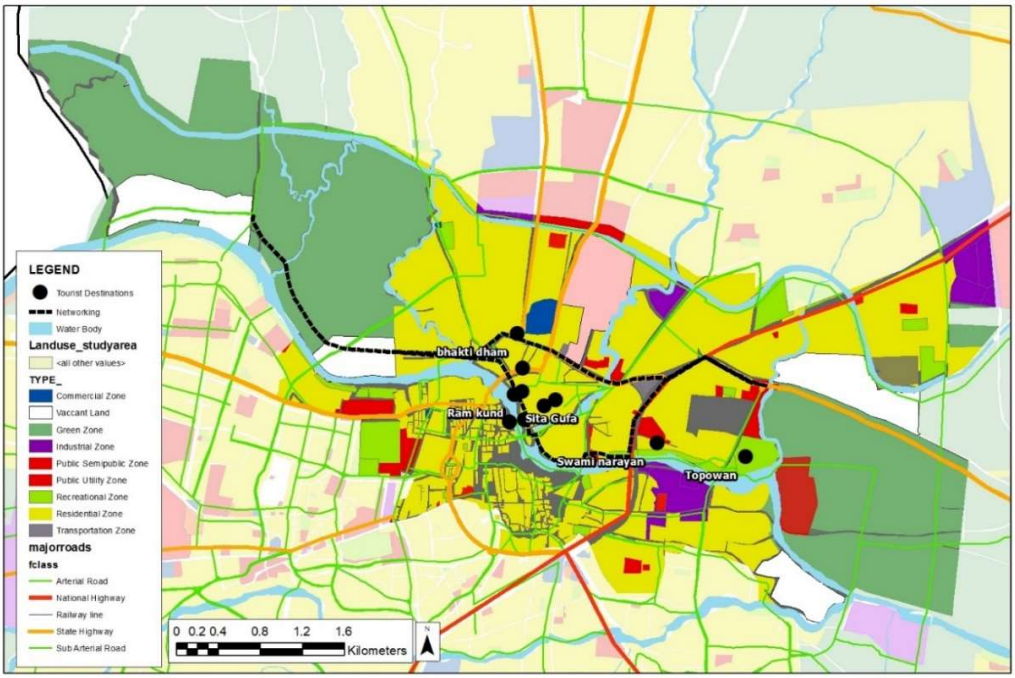


Figure 43 Network analysis

Correlation with Socio-Religious Activity: Overlay of priority wards with tourist footfall and major religious nodes.

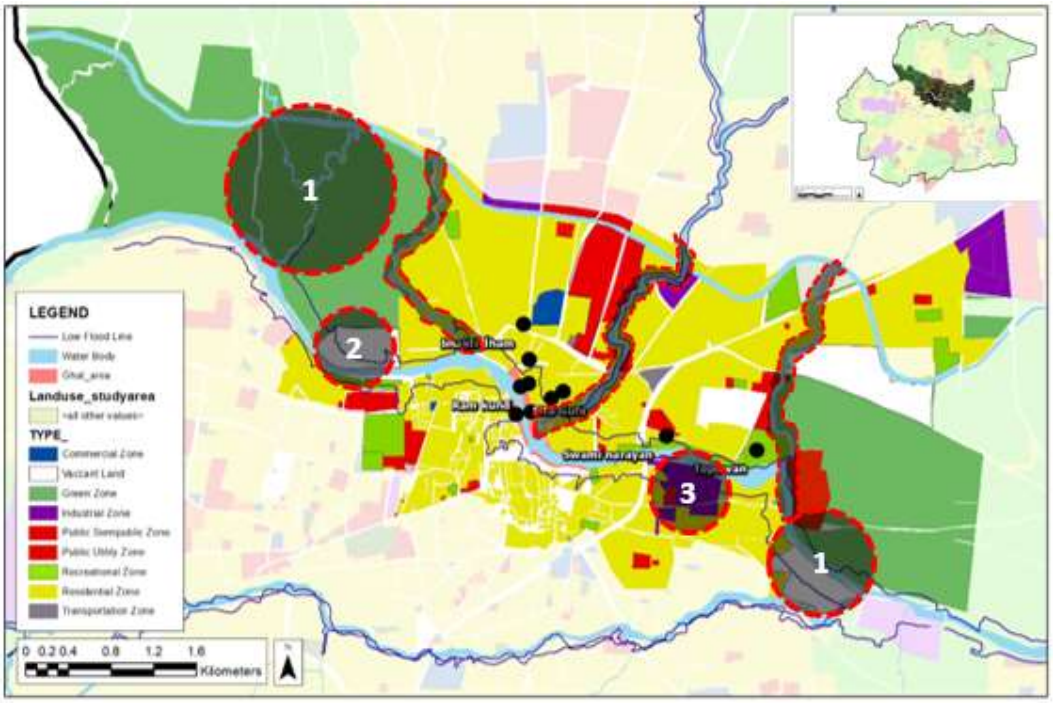


Figure 44 Overall Issues indetified in the study area

Zone 1, located on both the northern and southern ends, lies within ecologically sensitive green and recreational zones. These areas show potential for groundwater recharge and ecological restoration due to their open land cover and proximity to perennial streams and forest buffers, especially where urban runoff enters the Godavari.
Zone 2, the flood lines are not taken into consideration and dvopment of park is done.
Zone 3, relocation of the industrial area or frame guidelines for industrial setups to maintain standards.
Stretch along the nallahs and river has religious and residential zones, this area receives urban runoff and greywater from upstream. It is well-suited for bioswale networks.

6 CHAPTER 6: Proposals

The Godavari River, once a thriving natural system in Nashik, is witnessing ecological degradation due to rampant urbanization, concretization of the riverbed, and disruption of its natural hydrology. One of the most critical impacts includes the loss of natural springs, stagnation of water, and the decline in dissolved oxygen levels across the city's stretch, rendering the river ecologically dead. This proposal outlines a multi-pronged, phased strategy incorporating percolation tanks, bioswales, and constructed wetlands, aimed at restoring the river's ecological functions.

The spatial interventions are employed in three phases:

- **RECLASSIFY LAND USE (site1,3 &4)**

1. Agriculture to Integrated Constructed Wetland (IWC)
   This is constructed to filter out

I. Agricultural and residential waste.

ii. Wastewater from the STP and the river.

2. Industrial Area Reclassification (Site 3):

A currently industrialized area along the river will be rezoned for public, green, or recreational purposes. This will reduce environmental impact and serve as a buffer between urban use and river environment.

- **REJUVENATE RIVER/ NALLHAS (River edge)**

Bio-swales are constructed along riverbanks to filter stormwater runoff naturally.

- **ECOLOGICAL REVIVAL (River Stretch)**

Godavari River ecological revival with the help of tanks, buffer. Safe Storage for Use in Tourism After initial purification, divert excess water to a constructed pond/kund at a higher elevation or edge.Store in lined tanks or underground cisterns near ghats for safe non-potable uses.

Triveni" symbolizes the **three sacred essences**—Goda, Panchvati, and Tapovan.

6.1 Proposal 01 : Constructed Wetlands

Objective: Bioremediation and sediment capture before discharge into the river; biodiversity regeneration.

Proposed Locations: At the confluence of Wagadhi and near Tapovan STP. Zone 1 and 2 are critical as river confluence is observed and which flows through agricultural and residential areas. A buffer is mandatory over here to restore the tributaries. An artificial wetland can be constructed on one bank of the tributaries that has an agricultural part.

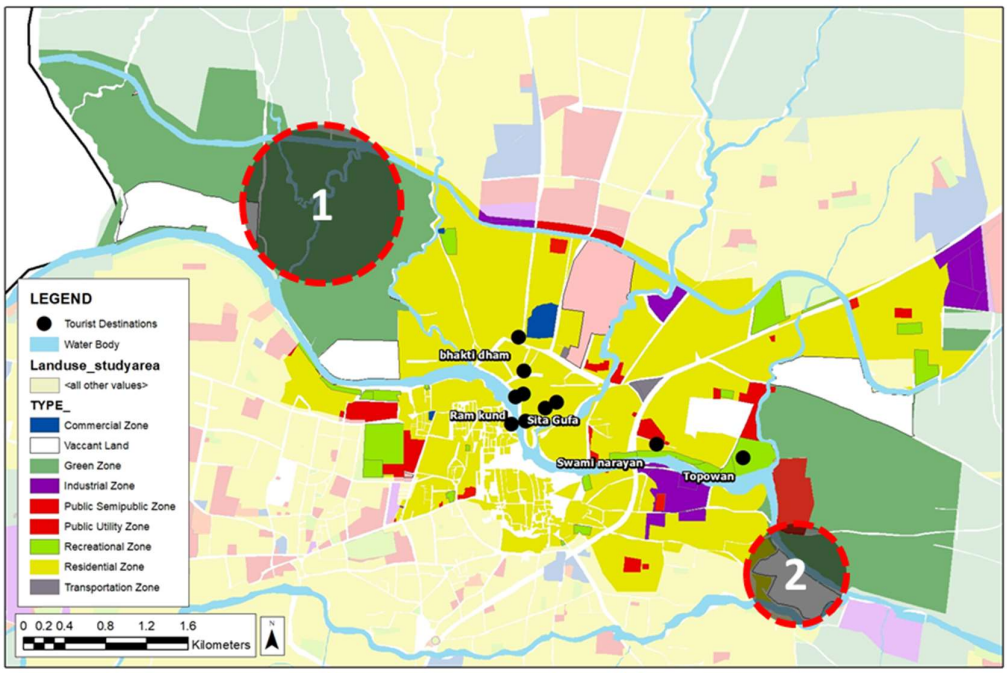


Figure 45 Identified area of intervention

A lot of agricultural activities are being carried out in river floodplains and river islands. The city needs to look into regulating agricultural activities, especially in floodplains and river islands.

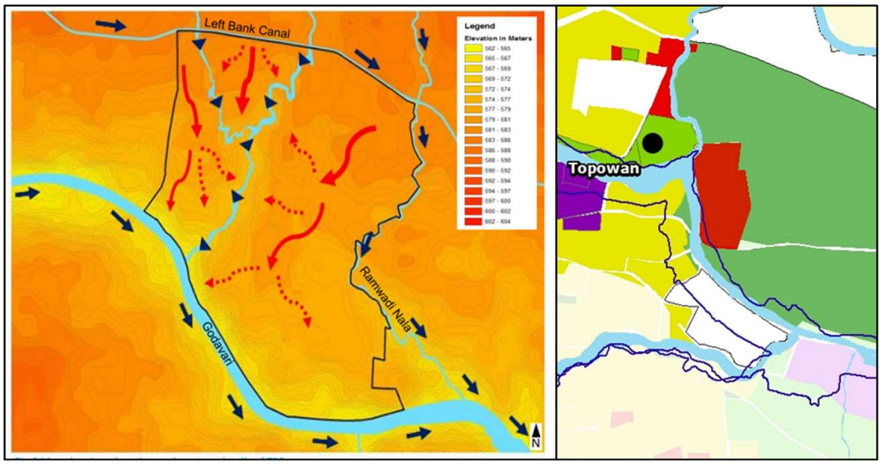


Figure 46 Existing morphology of the site

Intervention:

An 'Integrated Constructed Wetland' (ICW) is a series of shallow, interconnected, emergent-vegetated, surface-flow wetland compartments that receive/intercept waterflows from a variety of sources. ICWs can deal with domestic wastewater (primary, secondary or tertiary) and farmyard soiled water road/urban runoff and intercepted diffuse water-vectored pollution.

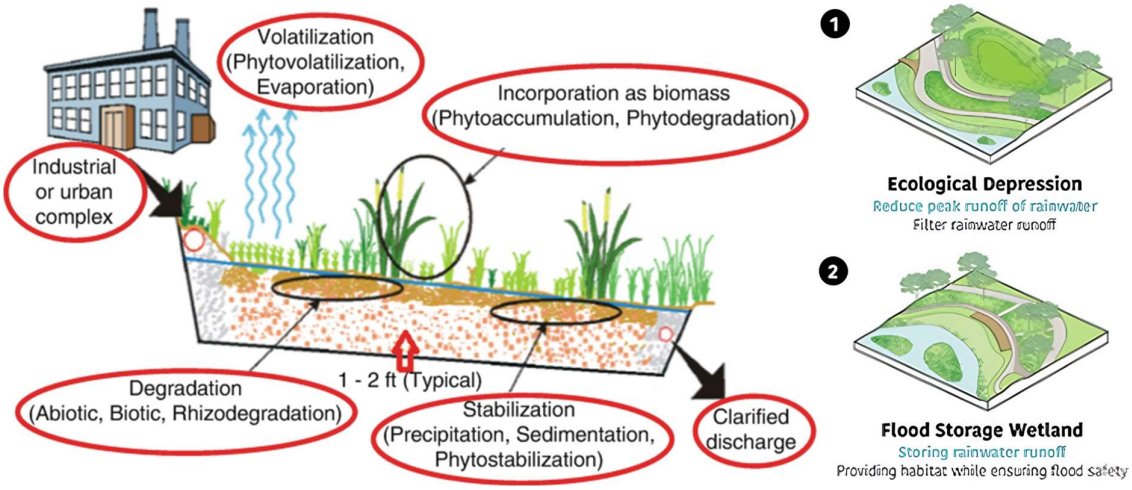


Figure 47 fucntion of wetland

Function:

i. Act as natural sponges during floods.

ii. Improve surface water quality before entering the Godavari river.

iii. This can be achieved with help of Phytoremediation.

Studies show that Pollutant removal over a hydraulic retention time (HRT) is of 25 days. Canna indica and Chrysopogon zizanioides are the most effective terrestrial plants for removing various pollutants from municipal sewage.

Design Recommendations:

Subsurface flow wetlands with gravel beds and emergent macrophytes (e.g., Typha, Cyperus). Integration with cultural trail/park to promote ecotourism. Capacity to handle monsoon runoff and dry season sewage.

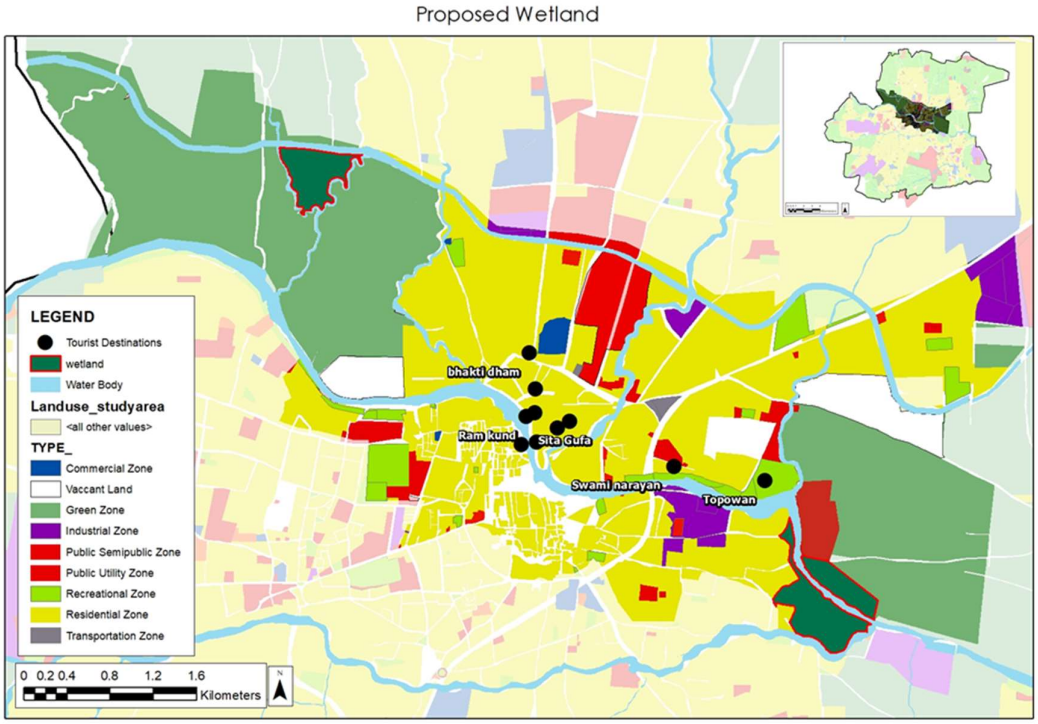


Figure 48 Proposed Intervention 1

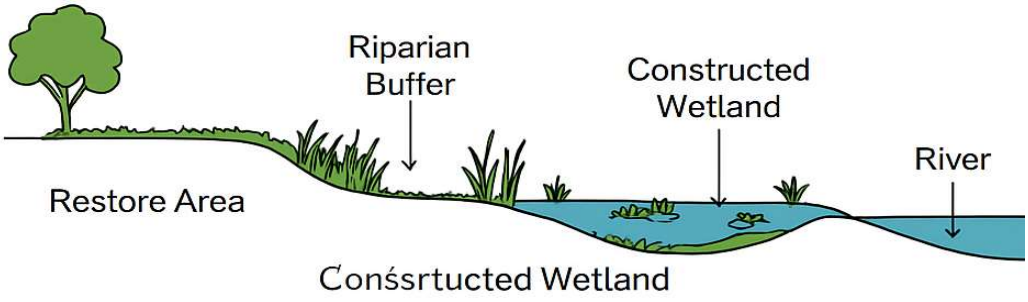


Figure 49 Conceptual site section for ICW

6.2 Proposed 02

Proposal for The design of new water intake facilities can follow the form of traditional water Wells. We superimposed the new water intake locations according to the natural conditions of the site (precipitation deposition + green space distribution) and social conditions (public space distribution + distribution of crowd activity).

Objective: Recharge groundwater and aid spring restoration, especially in agriculture-buffer areas. Water Security: Capture, store, and reuse rainwater sustainably. Urban Flood Control: Reduce surface runoff through infiltration and retention. Public Space Enhancement: Create accessible spaces for social, recreational, and cultural activities.

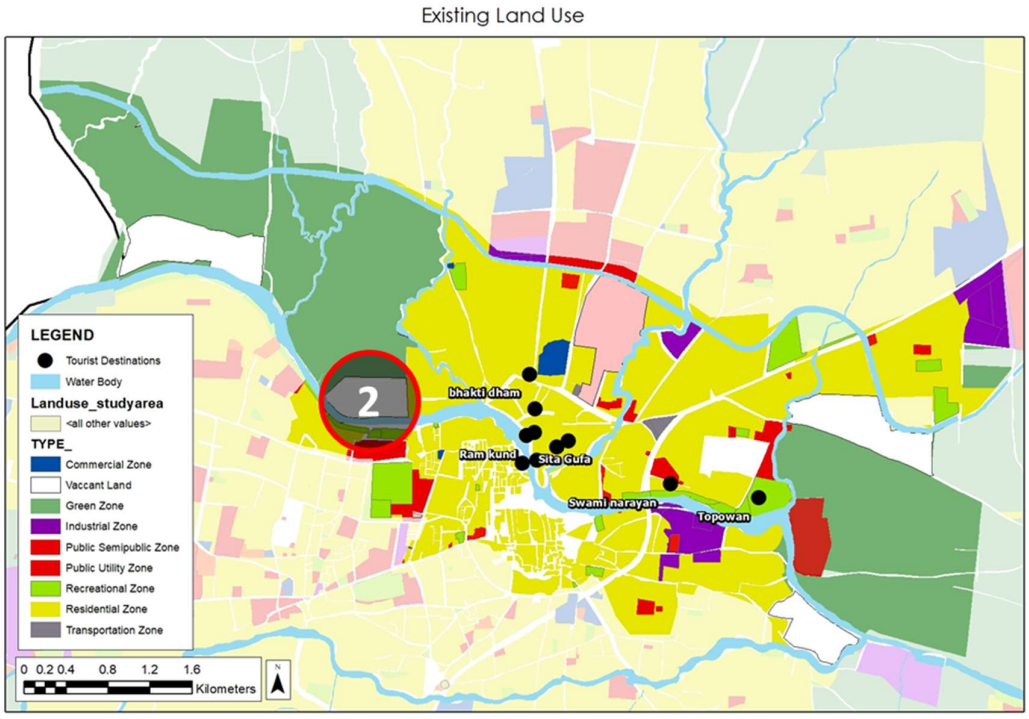


Figure 50 Identification of site for Proposal 2

Proposed Locations:

Along the northern agricultural buffer zone (100 m study buffer) where land is available. Adjacent to residential pockets in north-west Nashik (Wagadhi-Ramkund zone). along stormwater channels before entry into river.

Function:

In the dry season, the water source stored in the rainy season is transferred to transform the functions of religious activites at Ram kund, and other artificial tank, pond, provide public space that can be used for activities, and use water rationally to meet the needs

of drinking, irrigation, and animal husbandry. Water will be circulated within the ring by using the flood drainage pumps to maintain creativities and biodiversity during the dry season.

In the monsoon season, Restore the connection of the traditional water supply, kund, tank, well self-purify the water source through biological and physical means, and store water in the rainy season to avoid floods.This insures that the shallow aquifers if do not get recharged and when the concrete bed is removed the water is not soaked up. The tanks will help to restore the water. (CEPT Study, 2020).

Design Recommendations:

Cluster tanks in depressions with overflow connection to bioswales. Use permeable layers (sand, gravel) for efficient infiltration. Fenced with native vegetation buffer to prevent pollution.

Phased Development Strategy:

- Short-Term (0–2 years): Identify sacred sites in Core and Intermediate Buffers for kund retrofitting. Design kunds with percolation layers and water recharge capability. Conduct awareness drives with local priests and heritage groups.
- Mid-Term (2–5 years): Construct new kunds in newly pedestrianized zones. Include cultural interpretation centers nearby to distribute footfall. Connect kunds to bioswales and wetlands to form a closed-loop system.
- Long-Term (5–10 years): Promote kund trails as an alternative spiritual-tourist route. Ensure kunds contribute to base flow of river through sub-surface recharge. Use digital mapping for cultural-tourist routing across the extended zone.

6.3 Proposal 03

Objective: Filter and slow storm water runoff, reduce sediment and garbage flow into the Godavari.

Proposed Locations:

Stormwater paths draining into Ram Kund, particularly north-west zone.

Median strips along roads approaching the ghats.

Transition buffers between industrial and residential zones.

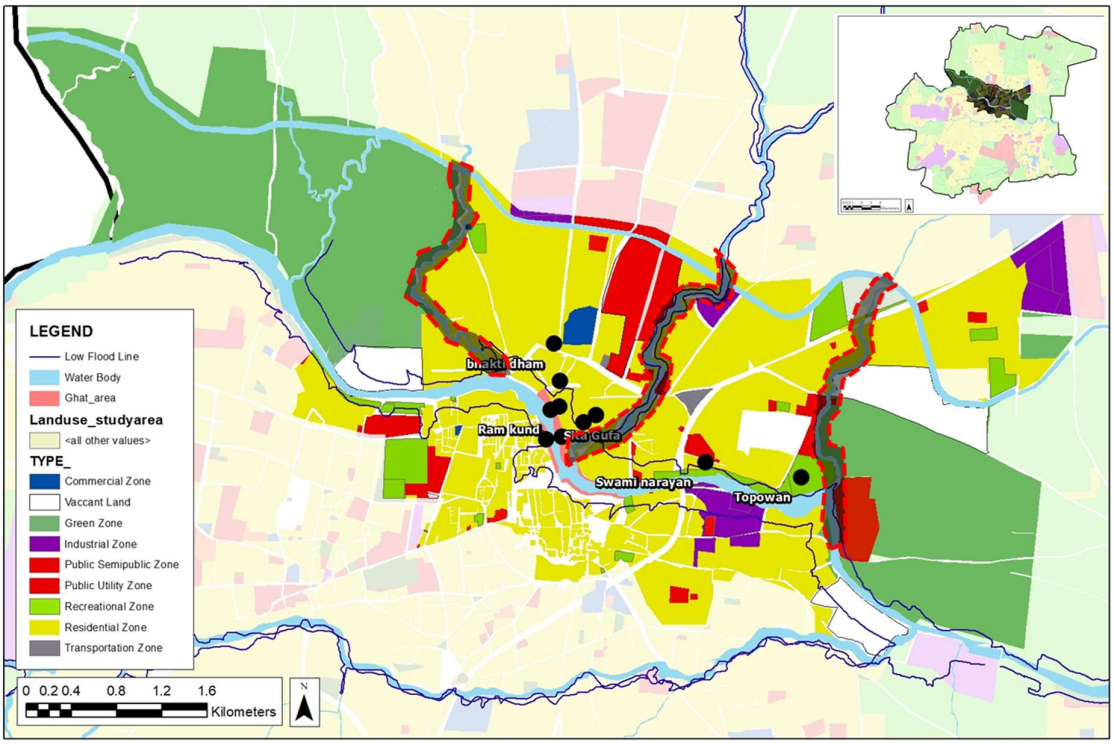


Figure 51 Indentification of confliting strecthes of drains

Figure 52 Existing condition of stretch

Design Recommendations:

Grassed or vegetated channels with check dams or baffles. Integration with percolation tanks at the terminus for infiltration.Low-maintenance native plants and a mulch-lined base for absorption.

Vulnerability: Water pollution during monsoons and festivals. Surface runoff carrying silt, oil, trash, fecal coliforms, and ritual waste into the river. Lack of natural filtration zones or stormwater detention.

Objective: Improve stormwater quality entering the Godavari.Promote groundwater recharge.

Function of bioswale & river emberkment:

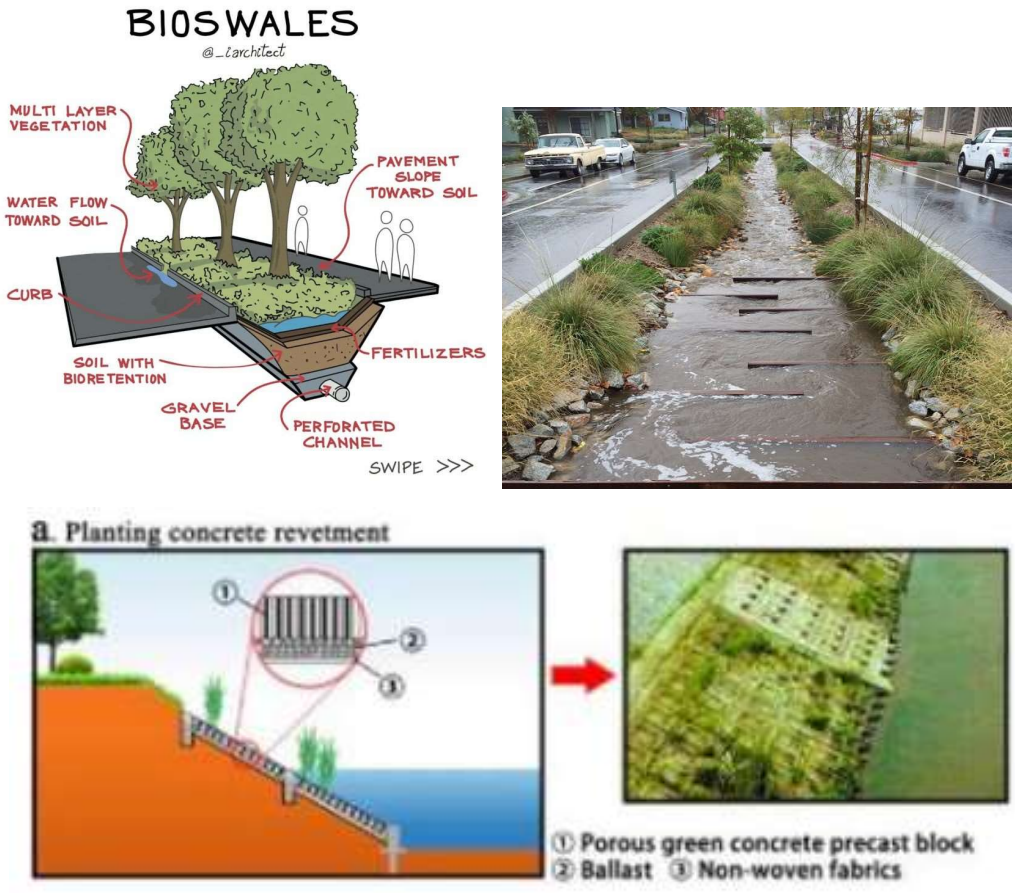


Figure 53: Section of river embankment

Phytoremediation Soil stabilisation Run off capture and groundwater recharge Supports urban biodiversity. Bioswales are engineered, vegetated linear ditches designed to manage stormwater runoff, improve groundwater recharge, and filter pollutants before water enters natural water bodies.

Implementation:

In the stretches where new construction is proposed or yet to be proposed, a minimum buffer of 3m and an ideal scenario 5m need to be allotted for riparian vegetation specifically. Within this buffer, it is recommended to avoid hardscape elements to the extent possible, and wherever necessity, permeable hardscape materials such as gravel, stone, permeable concrete pavers, porous pavers etc. may be used.

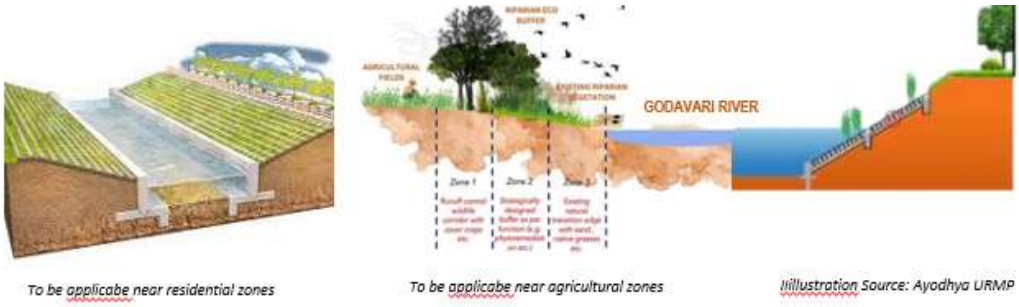

GODAVARI RIVER
To be applicabe near residential zones
To be applicabe near agricultural zones
Illustration Source: Ayodhya URMP

Figure 54 Section for the rihe bibuffer and bioswale

Incorporating bioswales, particularly in the vicinity of Ramkund and the Waghadi-Godavari confluence, provides an affordable, effective way to address pollution and urban runoff problems made worse by tourism. These natural solutions improve city's cultural landscape in addition to fulfilling practical hydrological functions.

6.4 Recommendations

1. Riparian Buffer Planning

A riparian buffer is proposed to protect the Godavari's ecological edge and recharge functions.

Table 16 Recommended Buffer width

Buffer Width	Applicability
100 m	Agricultural lands and spring zones (north edge of river)
30–50 m	Urban-residential zones, depending on availability
100 m (mandatory)	Industrial edge—regulatory enforcement for green belts + RWH

Buffer Elements:

Native vegetation and bamboo-based green fencing.

Informal walking/cycling trail along the buffer.

Swales, bio-retention cells, and interpretive signage for education.

2. Recommendation: Relocating Sewer Infrastructure Away from the Godavari River and Ecological Zones

To preserve the sacred and ecological integrity of the Godavari River in Nashik, especially around the heritage-rich ghat precincts, it is essential to plan sewer infrastructure away from environmentally sensitive and culturally significant areas. This aligns with the principles of river-sensitive planning under the Urban River Management Plan (URMP).

Key Recommendations

Establish a 100-meter "No Sewer Infrastructure" Buffer Zone

Prohibit the installation of sewer pipelines, pumping stations, or STPs within 100 meters of the riverbank to prevent contamination risks and infrastructural stress on the ghats.

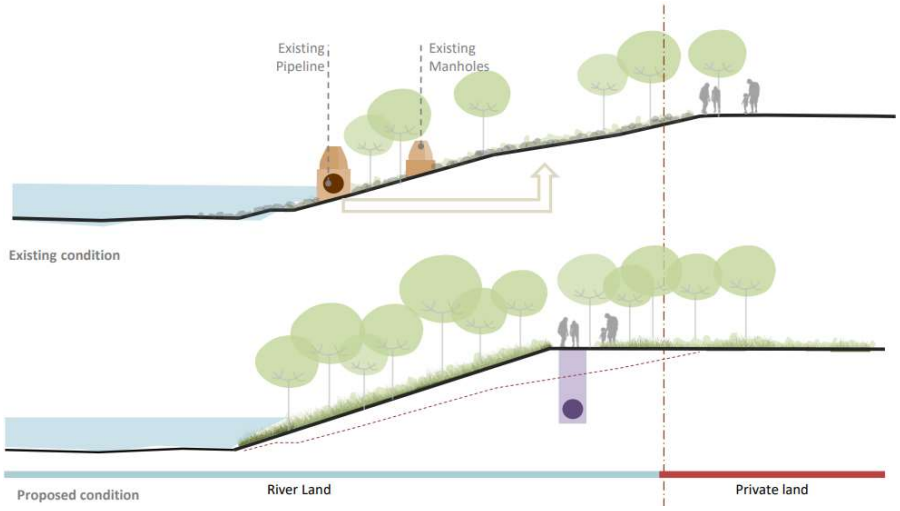


Figure 55 Proposed condition of Sewer connections

- Reroute Sewer Lines through Urban Corridors: Utilize less sensitive urban zones such as roads, backlanes, and utility corridors for the placement of trunk sewers. This helps avoid interference with riparian vegetation, aquatic systems, and heritage structures.
- Promote Decentralized Wastewater Solutions (DEWATS): Implement small-scale treatment systems near dense residential clusters to treat wastewater locally, thus reducing the load on centralized infrastructure and minimizing the need for riverside pipelines.

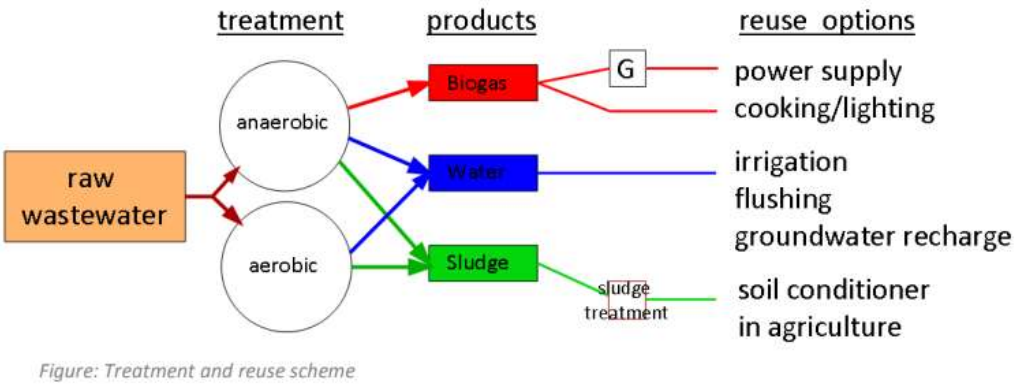


Figure 56 Treatment and reuse scheme

- Adopt Gravity-Based and Trenchless Technologies

Where feasible, sewer lines should follow natural terrain gradients to reduce energy use and operational risks. Use trenchless methods (like HDD) in ecologically or culturally sensitive zones to prevent surface disruption.

- Retrofit Existing Sewer Outfalls

Identify and redirect old or illegal outfalls currently discharging into the river. These should be connected to the re-routed trunk sewer network outside the buffer zone.

- Integrate Ecological Safety Measures

Include bio-barriers, leak-proof linings, and smart flow monitoring systems along all major pipelines to prevent any leakage into the groundwater or river system.

- Implementation Strategy

Conduct GIS-based mapping of all sewer lines, ecological boundaries, and heritage zones to inform rerouting.
Phase-wise execution starting with high-priority riverfront zones like Ramkund, Panchvati, and Goda Ghat.
Collaborate with municipal departments, environmental agencies, and local stakeholders for coordinated action.

- Expected Benefits : Protection of river water quality and biodiversity.

Preservation of religious sanctity of ghats and pilgrimage zones.
Enhanced resilience of riverfront infrastructure during high-flow and festival periods (e.g., Kumbh Mela).
This strategy ensures that urban infrastructure supports the city's growth without compromising the ecological and cultural value of the Godavari River.

3. Policy and Governance Recommendations

To safeguard the ecological integrity and religious-cultural sanctity of the Godavari River, it is essential to strengthen urban river governance through integrated planning, regulatory zoning, ecological monitoring, and community engagement. The following policy recommendations aim to operationalize sustainable river-sensitive planning in Nashik, while also creating institutional mechanisms for long-term management:

- **Eco-Sensitive Stormwater Management Code**

Integrate **Nature-Based Solutions (NbS)** like bioswales, bio-retention ponds, and green roofs into the **Municipal Building Bylaws** and Urban Design Guidelines.
Mandate the inclusion of **stormwater recharge systems** (percolation tanks, infiltration trenches) in all new urban developments—residential, institutional, and commercial.
Ensure stormwater systems are **disconnected from the sewer network** and instead routed through vegetated filters before entering water bodies.

- **Public-Private Participation (PPP) Mechanism**

Incentivize private entities, especially industries and large institutions, to create **ecological infrastructure** (e.g., wetland patches, detention basins) on their premises as part of **Corporate Social Responsibility (CSR)** and **Green Building Certification**.
Establish a **PPP policy framework** that supports the co-creation and maintenance of decentralized wastewater treatment systems and public green zones.

- **Ecological Monitoring Cell**

Set up a dedicated **River Ecology Monitoring Cell (REMC)** under the Nashik Municipal Corporation in partnership with academic institutions, NGOs, and citizen groups.
This cell will be responsible for:

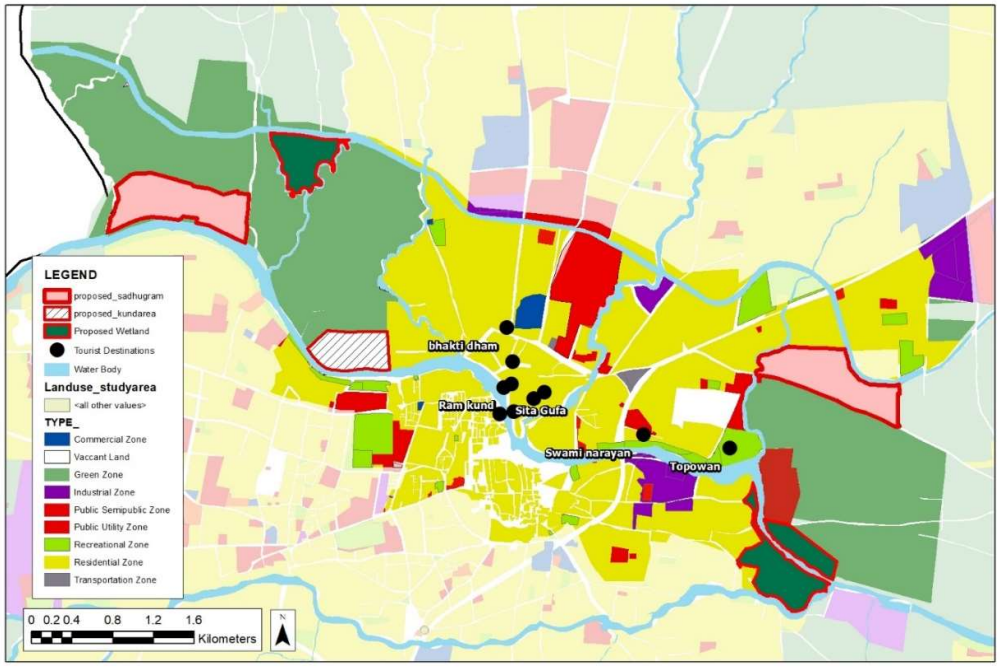
Monitoring Dissolved Oxygen (DO), BOD, and microbial loads

Assessing biodiversity (macroinvertebrates, fish, riparian flora)

Tracking **seasonal flow variations**, sedimentation, and riverbank erosion.

The data generated should inform adaptive planning and be made publicly available for transparency and engagement.

6.5 INFERENCE



The proposed interventions in the temple town aim to manage religious tourism sustainably while preserving ecological and cultural assets. The introduction of Sadhugrams in peripheral green zones seeks to decentralize accommodation for pilgrims, reducing pressure on the urban core. A Proposed Kund Area upstream emphasizes the restoration of traditional water bodies, enhancing both spiritual and environmental value. Similarly, a Proposed Wetland near the river and key religious sites like Swami Narayan and Tapowan supports ecological balance, flood management, and biodiversity. These interventions are strategically located near tourist destinations and within green, recreational, and public zones, aligning with sustainable urban planning principles. Collectively, they aim to improve visitor experience, protect natural resources, and reinforce the spiritual character of the city.

7 Conclusion:

This research highlights the effectiveness of a water-centric approach in revitalizing the social, ecological, and religious dimensions of sacred cities, using Nashik as a case study. By reframing water as a cultural and ecological asset rather than just infrastructure, the study emphasizes its central role in urban heritage. Through GIS-based spatial analysis, stakeholder engagement, and a zone-based scoring system, an integrated and adaptable framework was developed. This framework allows for context-specific strategies tailored to site typologies, environmental stress, and pilgrimage activity. The research addressed key challenges such as the neglect of traditional water systems, ecological degradation, and unmanaged tourism pressure, offering actionable solutions rooted in water-sensitive planning.

Beyond Nashik, the framework is replicable for other temple towns like Haridwar, Ujjain, and Pushkar, where religious and water heritage intersect. It provides a strategic foundation for sustainable, culturally informed urban planning. Ultimately, the study advances a broader discourse on sacred city resilience, promoting long-term cultural, ecological, and spiritual sustainability through integrated water management.

References:

- Travel & Tourism Development Index 2024. (2024). World Economic Forum.
- UNWTO. (2020). G20 TOURISM AND sdgs.
- Brito, M., & Silveira, L. (2023). Blue planning–a planning model for the development of Blue Tourism in Blue Spaces. Tourism Recreation Research. Https://doi.org/10.1080/02508281.2023.2167909
- Central ground water board. (2022). AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN NASHIK DISTRICT, MAHARASHTRA.
- Chandan, S., & Kumar, A. (2019). Challenges for urban conservation of core area in pilgrim cities of India. Journal of Urban Management, 8(3), 472–484. Https://doi.org/10.1016/j.jum.2019.05.001
- City Development Plan Alandi 2017- 2037. (2017).
- City Sanitation Plan for Nashik. (n.d.).
- COURSE 1: Introduction To Tourism. (N.D.). Http://Www.Wttc.Org
- CPCB. (2022). Polluted River Stretches For Restoration Of Water Quality-2022.
- Madurai Action Plan for Blue-Green Infrastructure indian cities. (2014).
- Ministry of Tourism. (2021). PRASHAD 15th FC Scheme Guidelines.
- Ministry of Tourism. (2023). India Tourism Data Compendium key highlights.
- Moud, P. M. (2016). "HRIDAY" Odisha Volume I of IV City HRIDAY Plan.
- MPCB. (n.d.). Action Plan For Environmental Improvement At - Alandi.
- Nashik Municipal Corporation. (2016). Revised Development Plan Of Nashik Municipal Corporation.
- Nashik Municipal Corporation. (2023). Nashik Municipal Corporation Environmental Status Report.
- National institute of Urban Affairs. (2020). A Strategic Framework for Managing Urban River Stretches in the Ganga River Basin.
- Pagare, P. A., & Gajhans, D. S. (2020). Cosmos Multidisciplinary Research E-Journal Tourist Perceptions Regarding Problem and Prospect of Religious Tourism in Nashik District. 5(3). Www.cmrj.in

- Shinde, K. A., & Olsen, D. H. (2023). Reframing the Intersections of Pilgrimage, Religious Tourism, and Sustainability. Sustainability (Switzerland), 15(1). Https://doi.org/10.3390/su15010461

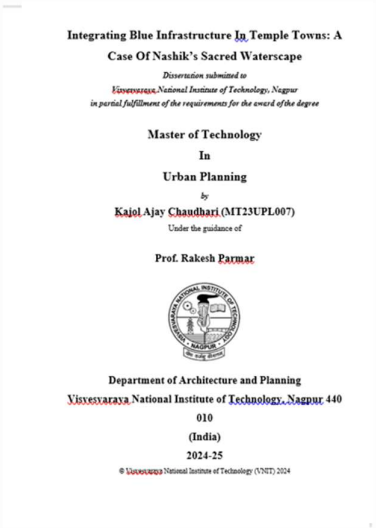
turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Kajol Chaudhrai
Assignment title:	Report Submission_Project Phase I
Submission title:	Integrating Blue Infrastructure in Temple Towns: A Case Study ...
File name:	Kajol_report.docx
File size:	27.58M
Page count:	48
Word count:	6,048
Character count:	36,193
Submission date:	02-Jun-2025 04:58PM (UTC+0530)
Submission ID:	2546088846



Integrating Blue Infrastructure In Temple Towns: A Case Of Nashik's Sacred Waterscape

Dissertation submitted to
Visvesvaraya National Institute of Technology, Nagpur
in partial fulfillment of the requirements for the award of the degree

Master of Technology
In
Urban Planning

by

Kajol Ajay Chaudhari (MT23UPL007)

Under the guidance of

Prof. Rakesh Parmar

Department of Architecture and Planning
Visvesvaraya National Institute of Technology, Nagpur 440 010
(India)
2024-25

© Visvesvaraya National Institute of Technology (VNIT) 2024

Copyright 2025 Turnitin. All rights reserved.

Integrating Blue Infrastructure in Temple Towns: A Case Study of Nashik's Sacred Waterscapes

ORIGINALITY REPORT

11%	8%	4%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.econstor.eu Internet Source	2%
2	Submitted to Savitribai Phule Pune University Student Paper	1%
3	www.asla.org Internet Source	1%
4	Submitted to Visvesvaraya National Institute of Technology Student Paper	1%
5	epw.in Internet Source	1%
6	pdffox.com Internet Source	1%
7	dspace.uevora.pt Internet Source	<1%
8	mafiadoc.com Internet Source	<1%
9	utopiancities.wordpress.com Internet Source	<1%
10	awsassets.wwfindia.org Internet Source	<1%
11	nios.ac.in Internet Source	<1%

12	www.vimage.cn Internet Source	<1%
13	Submitted to Global Banking Training Student Paper	<1%
14	multimedia.elsevier.es Internet Source	<1%
15	tourism.gov.in Internet Source	<1%
16	Submitted to City of Glasgow College Student Paper	<1%
17	cgwb.gov.in Internet Source	<1%
18	Kuok King Kuok, Muhammad Khusairy Bin Bakri, Chiu Po Chan, Md. Rezaur Rahman et al. "Merits of bamboo utilization in earth preservation, water, and wastewater treatment: A mini review", BioResources, 2024 Publication	<1%
19	Bandyopadhyay, Ranjan. "Representative dissonance in heritage tourism in India", Proquest, 20111109 Publication	<1%
20	docslib.org Internet Source	<1%
21	www.aaas.org Internet Source	<1%
22	www.comptoncity.org Internet Source	<1%

23	"Geospatial Technologies for Integrated Water Resources Management", Springer Science and Business Media LLC, 2024 Publication	<1%
24	Mahesh Gogate. "The Sacred Waters 'of' VARANASI - The Colonial Draining And Heritage Ecology", Routledge, 2023 Publication	<1%
25	www.abacademies.org Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		